JAN -
VET. MED. LIBRARY

THE JOURNAL OF THE BRITISH VETERINARY ASSOCIATION

OHIO STATE UNIVERSITY
JAN 4 1961
LIBRARY

The Veterinary Record

PATRON: HER MAJESTY THE QUEEN

Vol. 72 No. 48 Issue No. 4305 1065-1100

Registered as a Newspaper

XUM

BRITISH VETERINARY CODEX *supplement 1959*

The number of new medicaments which have been introduced and the improvements in methods of formulation which have been devised since the British Veterinary Codex was published have made it necessary to issue a Supplement to the main volume.

The Supplement contains 89 additional monographs of which 47 provide standards for new drugs, 7 for vaccines and antisera and 35 for new formulæ, with a number of additions to and amendments of the appendixes. As with the main volume there is a comprehensive therapeutic and pharmacological index. Whenever applicable comprehensive details are given of the action and uses and doses for a variety of animals of the substances described. In addition, the Supplement amends a number of the monographs of the British Veterinary Codex, in fact, the two books are complementary.

Price 35s. (Postage and packing 1s. 3d inland, 2s. overseas) Pp. xviii+134

THE PHARMACEUTICAL PRESS 17 Bloomsbury Square, London, W.C.1

KETOSIS TREATMENT

KETOSIS TREATMENT *contains propylene glycol and cobalt. Propylene glycol is non-toxic and is not destroyed by rumen micro-organisms, and it leaves neither undesirable residues nor oxidation products. It does not mask complicating infections. Both Acetonaemia and Pregnancy Toxaemia respond well to treatment with* **KETOSIS TREATMENT.**

Available in 1, 2 and 5 gall. cans.

Prices and literature available on request.

SOMERSET PHARMACEUTICALS LTD.
Wellington, Somerset.
Telephone: Wellington, Som. 2244

THE VETERINARY RECORD

Founded by William Hunting, F.R.C.V.S., in 1888

Volume 72
No. 48

SATURDAY, NOVEMBER 26th, 1960

7 Mansfield Street,
London, W.1.
Museum 6541

Research in Veterinary Science

AT its meeting on January 10th, 1959, the Council of the British Veterinary Association approved a recommendation from its Editorial Committee that a new journal, whose content would be devoted exclusively to original research, should be brought into being. In making that decision Council had in mind the increasing number of papers which were coming forward from veterinary laboratories, institutes and schools, the resulting pressure on existing publications, the increasing time lag between acceptance of papers and their publication, and the knowledge that this situation would become more, and not less, difficult. The Association of Veterinary Teachers and Research Workers had added the weight of its authority to that of the Editorial Committee, and there existed a fairly general feeling that the B.V.A. ought to be the body to sponsor the new, quality publication for which the circumstances of the times seemed to call.

Later, it was decided that the new journal should be named *Research in Veterinary Science*, and that its broad policy should be to " publish articles which form original contributions to knowledge on health and disease of animals." Council voted a sum of money to launch the new venture, an Editorial Board of senior workers was invited to serve and elected Dr. A. W. Stableforth as its chairman, while Mr. H. E. Harbour accepted the Board's request to act as honorary scientific editor, assisted by Dr. J. B. Brooksby and Professor D. L. Hughes. The first number of *Research in Veterinary Science* was scheduled for January, 1960.

In October this year the fourth of the quarterly issues was published, thus completing the first volume, and it may be of interest to consider how the journal has fared.

Forty-nine papers, comprising a little under 400 pages have been published, and the main subject matter, by percentage, has been as follows; bacteriology 24 per cent., biochemistry and physiology 19 per cent., virology 14 per cent., pathology 10 per cent., anatomy and chemotherapy each 8 per cent., and general medicine 6 per cent. These percentages do not, necessarily, set the pattern for the future; they reflect the numbers of papers of sufficiently high quality which have been offered and accepted for publication during the first year; a harmonious balance between the various disciplines is the Editors' aim. At present the delay between acceptance and publication compares favourably with that of other scientific journals, and if the accumulation of papers should lead to an over long waiting list the size of *Research in Veterinary Science* will be increased. With the help of the publishers, Blackwell Scientific Publications, of Oxford, the circulation is being steadily built up, and the journal is at present being read in more than 40 countries including those of eastern Europe and Asia. There is ground for cautious hope that the capital sum voted by Council will be but little, if at all, encroached upon as the result of the first year's working.

It is generally conceded that in appearance, typography and quality of illustration our new publication is the equal of its contempories and reflects the modern tendency that learning need not be dressed in shabby clothes. The printers have done a good job: and even though good wine may need no bush it is none the worse for an agreeable label on the bottle. But appearances are superficial and any journal must stand or fall on the quality of its content. It has been the Editors' aim to set and to preserve a high standard; and that standard will, by intention, be not merely maintained but enhanced as *Research in Veterinary Science* becomes increasingly established in the scientific libraries of the world.

It may be that some members of the Association will ask what the progress of so specialised a publication has to do with them. The answer is twofold: research is the life-blood of their profession, and as such is indispensable to each individual veterinary practice; secondly, the production of a journal of quality makes known to workers in other fields, to Government Departments and official personages the achievements of veterinary science, and this adds to the prestige of every veterinarian. It would be premature as yet to rejoice over success; but a promising beginning has been made and a page turned in the history of our Association.

XUM

Congress Papers

SYMPOSIUM ON HUSK*

(1) The Disease Process

BY

W. F. H. JARRETT, F. W. JENNINGS,
W. I. M. McINTYRE, W. MULLIGAN,
N. C. C. SHARP and G. M. URQUHART
University of Glasgow Veterinary School

SUMMARY.—A brief account is given of the lesions and clinical signs associated with Dictyocaulus viviparus *infection in cattle. The progress of the disease is divided into prepatent, patent and postpatent phases, according to the stages of the parasite's life cycle. The complications caused by emphysema, heart failure and other pneumonias are also briefly described.*

"HUSK" or parasitic bronchitis is a complicated disease clinically, pathologically and parasitologically. In the following short account we have made an attempt to present it in as clear a form as possible and we are very well aware that this has involved simplification and over-categorisation; also, we have not dwelt at any length on controversial points. We think that the need to understand the various stages of the disease in the context of the present symposium justifies this form of treatment.

The Uncomplicated Disease

"Husk" may be divided into 4 stages:—

Penetration by the larvae into the body and their migration to the lungs.

The development of the larvae in the lungs—The Prepatent Phase.

The period when the worms are mature and egg producing—The Patent Phase.

The period at the end of the disease when there may be a flare-up of severe pulmonary symptoms—The Postpatent Phase.

The timing of these stages may approximately and conveniently be summarised as follows:—

1. Penetration phase, days 1 to 7.
2. Prepatent phase, days 7 to 25.
3. Patent phase, days 25 to 55.
4. Postpatent phase, days 55 to 70.

The recognition of these various stages is of great importance to the veterinary surgeon concerned with giving advice on prognosis, treatment and prophylaxis.

1. *The Penetration Phase*

This is of little clinical significance as respiratory signs are not usually seen in the first week of infection unless the infecting dose has been a very large one. It is, therefore, normally safe to assume that animals showing obvious respiratory effects have been infected more than one week previously.

* Symposium of papers presented to the Annual Congress of the British Veterinary Association in Glasgow on Friday, September 2nd, 1960.

2. *The Prepatent Phase*

This is very important clinically. The main underlying lesion is blockage of small bronchi and bronchioles by the eosinophil exudate produced in response to the small developing larvae migrating up the bronchi (Fig. 1). It is important to realise the difference between this lesion and the pneumonia produced later by adult worms. The blocked bronchi are not permanently damaged but the obstruction to air passing in results in collapse of the alveoli distal to the block; as the air in these alveoli is absorbed into the blood and as no more takes its place, the alveoli collapse and are lost as functioning units. If the blockage is removed, these alveoli can return quickly to normal function.

The clinical picture depends on the size of the infecting dose as this determines the extent of bronchial involvement and the speed of development of the severely ill case. In heavy infections there is often a dramatic change in the clinical signs towards the end of the second week; in the course of 4 or 5 days the respiratory rate doubles, reaching 70 to 80 per minute and coughing becomes marked. Towards the end of the third week, as the primary bronchial lesions regress, there is often a noticeable deceleration in the progress of the disease, although the animals are still ill and deterioration in condition continues.

In the third week, death may occur in heavily infected animals; this is usually associated with the development of acute complications (see below—Complications).

If an animal is autopsied in the prepatent phase, worms may not be seen; in the later part they are visible, but microscopic examination by direct smear of bronchial mucus is necessary if they are to be found during the second and early third weeks. Many acute pneumonias are not diagnosed as husk because of this fact.

3. *The Patent Phase*

This stage is associated with the presence of adults in the bronchi, and, while these cause much exudation into, and blocking of, air passages, a great deal of the clinical effect is caused by the primary parasitic pneumonia in which macrophages and giant cells engulfing aspirated eggs and newly hatched larvae, consolidate the lung lobules (Fig. 2). In most cases it is this pneumonia and not secondary bacterial complications which produces the typical picture at autopsy.

The respiratory rate may become faster than the pulse rate, rising to over 100 per minute, coughing

W. F. H. JARRETT—"HUSK"—THE DISEASE PROCESS

G. 1.—Example of a small bronchus completely blocked by eosinophil exudate.

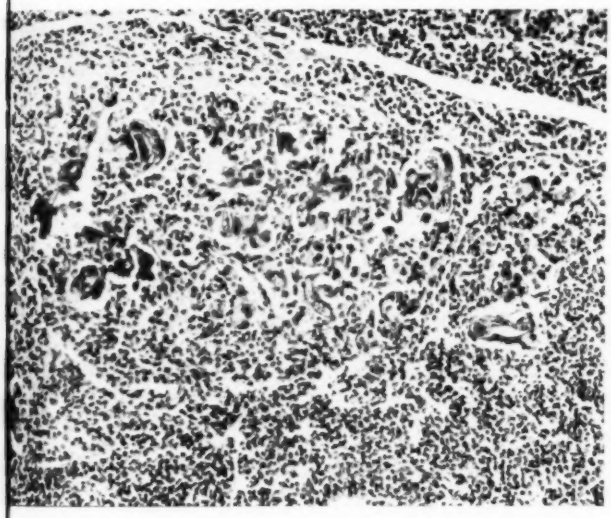
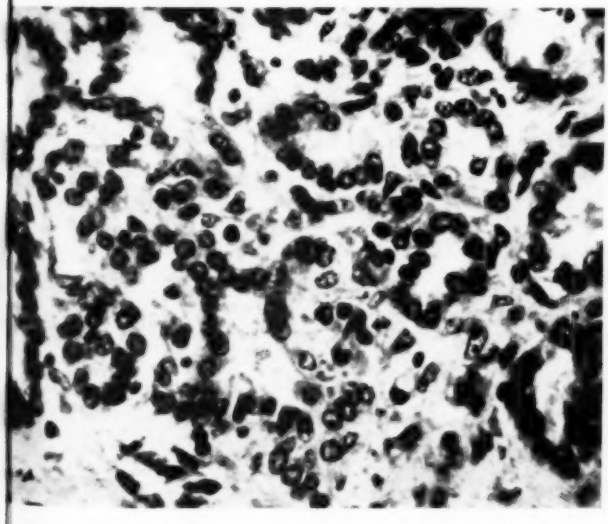


FIG. 2.—Foreign body reaction to eggs and first-stage larvae.



G. 3.—Alveolar epithelialisation. Note thickened gland-like alveolar walls.

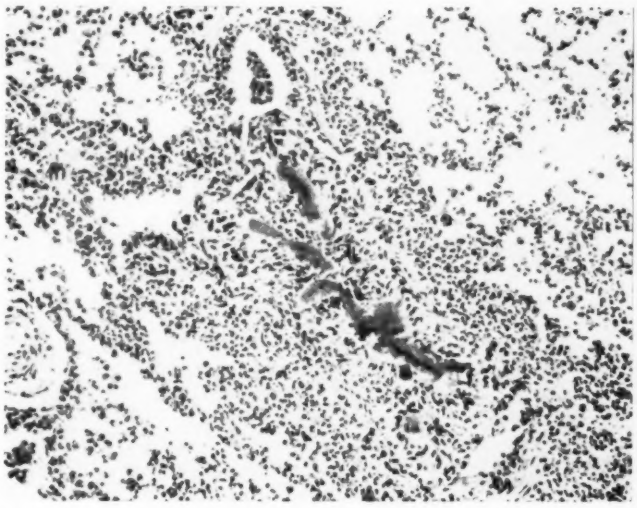


FIG. 4.—Bronchial epithelial proliferation in response to dead larvae.

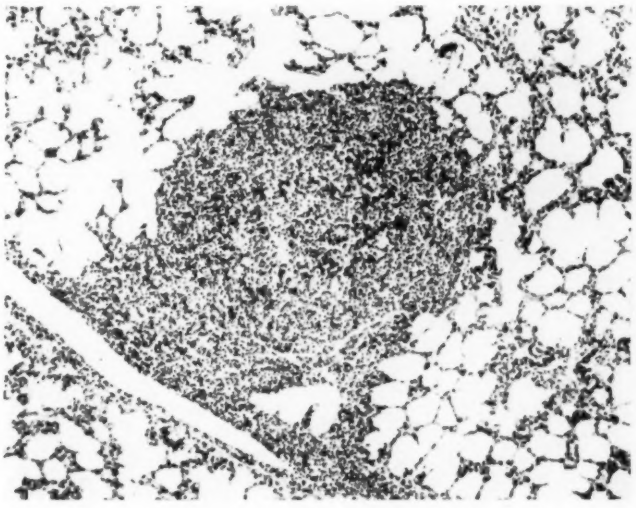


FIG. 5.—Bronchiolar damage and lympho-reticular reaction caused by dying larvae.

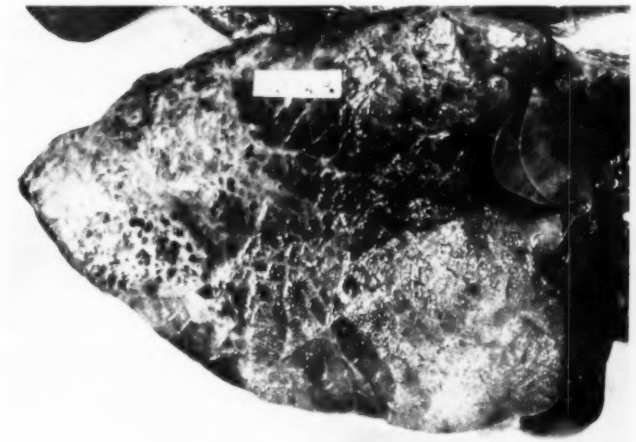
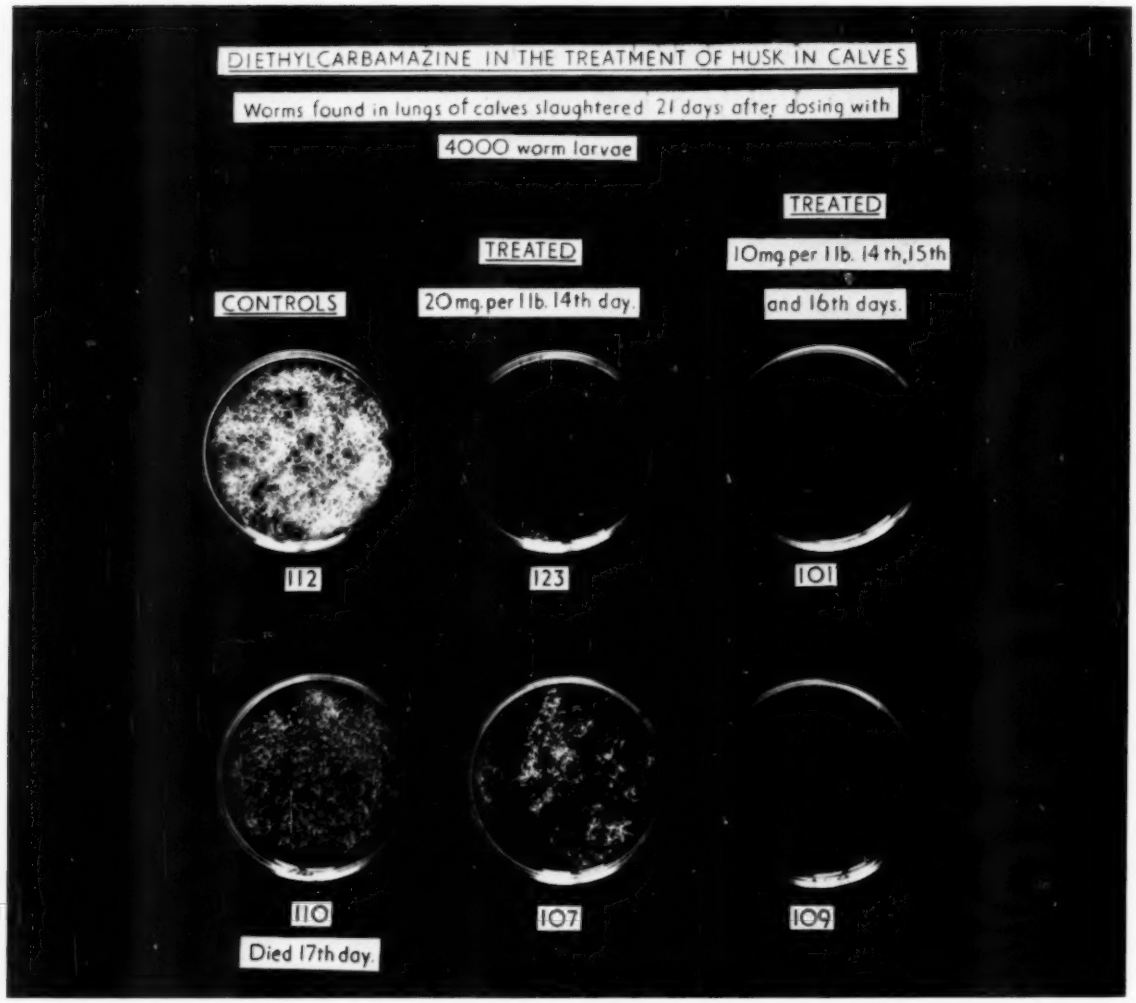


FIG. 6.—Calf lung showing widespread emphysema in a diaphragmatic lobe.

XUM

W. H. PARKER—TREATMENT WITH DIETHYLCARBAMAZINE



becomes more frequent, appetite is lost, and growth ceases. On auscultation harsh bronchial breathing is evident and this may be augmented by emphysematous crackling or fluid sounds as complications supervene in serious cases. Dehydration may become very marked. During this period many animals die; in the survivors there is a slow regression of symptoms after the fifth week.

During this central stage of the disease the adult worms are laying eggs which hatch in the lungs or intestine and may be detected in faeces as larvae. Counts usually range from about 100 to 500 per gramme but higher levels are not infrequent. At autopsy the adult worms are easily seen in the trachea and bronchi and range in number from a few hundred to several thousand.

4. *The Postpatent Phase*

In this phase the majority of animals gradually recover; the respiratory rate steadily decreases, coughing lessens, and weight increase is resumed. Compete recovery, however, is apparent only after a lapse of several months.

In approximately a quarter of those animals which were severely affected the postpatent phase is different from the above and is characterised by a sudden exacerbation of the dyspnoea during the seventh or eighth weeks, which is often fatal. This is caused by the spread of a lesion, the aetiology of which is not known at present. During the patent phase, many alveoli show a swelling and proliferation of their epithelium so that instead of a thin membrane, easily permeable to gases, a thickened gland-like wall develops (Fig. 3). In the postpatent phase, this alveolar epithelialisation spreads to involve whole lobes and obviously this proliferative pneumonia has serious clinical consequences. By the time it has become widespread, all, or almost all, of the worms have been shed from the lungs and so the findings at autopsy are not those associated with patent parasitic bronchitis. But the presence of large areas of red or pink rubbery lung which are not friable and consolidated, and which on palpation still show some crepitance should lead to suspicion of this stage of husk.

Reinfection Phenomena

Animals which have become immune to *Dictyocaulus viviparus* may show symptoms after reinfection, the magnitude of these varying with the numbers of larvae ingested. When these larvae penetrate into the body, a number may reach the lungs and be killed in small bronchioles; these dead larvae cause quite a marked reaction and if there are many of them, an obvious and sometimes even fatal clinical condition results. The lesion is seen in Figs. 4 and 5. The dead larvae cause a proliferation of epithelium and the development of fibrous and lymphoid nodules around the air passages. Usually, however, only mild coughing is caused, the lesion resolves quickly and the animal returns to normal in a short time. This process may be seen when vaccinated animals are first exposed to heavy infection. It is also frequently seen in outbreaks in adult cattle where presumably immunity has waned and a moderately large number of larvae reach the lungs before being killed. This may produce the sudden onset of severe and persistent coughing in a whole herd of adults with a number showing signs of severe pneumonia. Naturally larvae are not found in the faeces of these cases, although all of the other clinical signs of husk may be present.

Complications

These may be classified as:—

(a) Occurring during the course of the disease:—
  (1) Pulmonary oedema.
  (2) Emphysema.
  (3) Secondary bacterial infection

and (b) occurring as sequelae:—
  (1) Bronchiectasis.
  (2) Pulmonary fibrosis.

Pulmonary Oedema

This is one of the most serious complications and is the frequent cause of sudden clinical deterioration; the onset of heart failure in a dyspnoeic animal is the main cause. The alveoli become filled with transuded fluid and this, together with the laying down of protein-containing "hyaline membranes" on the alveolar walls, causes a serious diminution in the already reduced gas-exchanging area of the lungs. This augments the parasitic pneumonia and leads to further anoxia and a rapid deterioration in clinical condition.

These changes are accompanied by a marked decrease in the volume or strength of the arterial pulse. Only occasionally is it possible to detect fluid râles on auscultation.

Emphysema

This frequent complication is usually of the interstitial type (Fig. 6). The lobules of the bovine lung are separated by loose fibrous tissue and air may enter this from ruptured bronchioles. This air travels along the septa and may increase in volume to form large bullae. The lung is then incapable of proper contraction and respiratory distress becomes more marked.

The advent of emphysema is readily recognised clinically by the distinct and widespread crackling sounds heard on auscultation. Infrequently the emphysema may extend *via* the thoracic inlet to the subcutaneous tissues over the thorax and abdomen.

Secondary Bacterial Infection

This is less common than is generally supposed, although it is frequent enough to justify the use of antibiotics in severe husk cases. The green pus often seen in the lungs of parasitic bronchitis cases is composed of eosinophil leucocytes exuded in response to the parasites and not to bacteria. However, acute interstitial pneumonia may be superimposed infrequently and the occurrence of this complication may be suspected when moderately tachypnoeic cases suddenly became anorexic and very dull. Recumbency and death may ensue within 48 hours.

(*Concluded at foot of page* 1068)

(2) The Use of Cyanacethydrazide

BY

J. K. WALLEY

Knutsford, Cheshire

SUMMARY.—1. *The requirements and use of an anthelmintic against lungworms are discussed.*

2. *The critical evidence of the high anthelmintic activity of cyanacethydrazide against* Dictyocaulus *species is reviewed.*

3. *The use of cyanacethydrazide for the treatment of lungworm infestation in cattle is reviewed and the evidence to date shows that it is the anthelmintic of choice against lungworms resident in the air passages.*

4. *The use of cyanacethydrazide in the prevention of parasitic bronchitis is discussed and evidence of the value of regular monthly dosing is presented.*

5. *The safety of the therapeutic oral and subcutaneous dose levels of cyanacethydrazide have been confirmed.*

Introduction

IN this symposium we are concerned with lungworm infestation of domestic animals with particular reference to "husk" in the bovine animal. The concern of this paper is to review the published work on the use of cyanacethydrazide ($CNCH_2CONHNH_2$) ("Dictycide,"* "Helmox"*) an anthelmintic against the lungworm species.

The ideal anthelmintic for use in lungworm infestations would be active against the migrating immature worms as well as those worms (immature and mature) in the air passages of the lungs. To date, neither cyanacethydrazide nor any other drug has been demonstrated by critical trial to be sufficiently active to be of practical use against the migrating larvae. The effect of irradiation of infective *Dictyocaulus* larvae, with the development and practical use of an oral vaccine against *Dictyocaulus viviparus* in cattle will be discussed later in this symposium.

The tissue damage caused by migrating larvae is well known and once animals have become infected with lungworms and this has produced the changes associated with the characteristic cough or "husk," it will be appreciated that there is no dramatic "cure for husk." The exciting causal organisms can be expelled, and the natural recovery processes can then occur in the lungs. Meantime, however, the animal will maintain and improve its condition under conditions of good husbandry.

For the treatment of lungworms, once they are established in the lungs of the animal it is necessary to have a safe, easily administered drug which is highly effective against all the stages of the worm in the air passages and capable of activity in lungs which may have undergone considerable change and organisation due to the infection. Generally, in a herd, animals will be in various stages of the infection.

The main object of therapy is to remove the causal organisms, to allow the lungs to undergo natural recovery, and to permit natural immunity to develop. This immunity would not develop if the drug killed the migrating larvae before they had passed through the mesenteric glands, or, if it killed them in the bloodstream there would be serious risk of embolism —pulmonary or even cerebral.

* Trade marks of Imperial Chemical Industries Limited.

The Disease Process.—*Concluded.*

Bronchiectasis

After some husk infections, the bronchi of a lobe fail to clear themselves of exudates and these become the nidus of low-grade chronic bacterial infections. Slowly the bronchi dilate and the lobules collapse until the lobe becomes transformed into several tubes of viscid pus. This is a common cause of the poorly thriving stunted animal with a persistent cough and economic therapy is not possible.

Pulmonary Fibrosis

This may remain after an infection in the intra- or peri-bronchial sites or in the septa, but while it may give rise to a mild chronic cough, it is not generally of much clinical significance.

Cuffing Pneumonia

We have discussed this disease fully elsewhere and it is included here as a reminder that its symptomatology is identical to that of husk and that the superimposition of parasitic infection upon this disease leads to a more severely affected animal.

From this brief account it is apparent that the disease processes initiated by *D. viviparus* are complex; furthermore in one group of calves the various phases of the disease may be encountered simultaneously in different animals. In general, however, the appearance and severity of clinical signs are determined by the numbers of larvae ingested and the immune status of the host. In our experience the intake of larvae is very difficult to control effectively by grazing techniques and in our opinion the solution to the problem of parasitic bronchitis or "Husk" depends on vaccination or specific therapy. While it is obvious that a disease of such complexity should be prevented if possible, it is also of great importance to have an effective remedy to assist the dilatory stock-owner to reduce the losses which he might have prevented altogether by earlier vaccination.

Diagnosis of lungworm infection is not always easy, and a *specific* anthelmintic will be of no value unless worms are present. In the field it is certain that, in season, some indiscriminate dosing occurs which can have no effect on the course of the non-existent "husk." Veterinary surgeons' reports on the successful use of antibacterial agents in cases where lungworm anthelmintics have apparently failed strongly suggest a bacterial rather than a parasitic infection. In those cases where there is a simultaneous infection with other worms, bacteria or viruses, simultaneous treatment against lungworms and the intercurrent disease must be practised.

As with other anthelmintics, it is necessary when treating for lungworm to give the correct dose—false economy of material or under-estimation of live-weight (especially in those areas where animals are not normally sold by weight)—leads to ineffective dosing. Correct dosing with a good formulation of an effective anthelmintic can control the course of "husk" in the bovine animal.

The Anthelmintic Activity of Cyanacethydrazide

Since the marked anthelmintic properties of cyanacethydrazide ($CNCH_2CONHNH_2$) were first demonstrated (Walley, 1957) against the various species of lungworms normally resident in the air passages, *e.g. Dictyocaulus viviparus* in cattle, *D. filaria* in sheep, and *Metastrongylus apri* in pigs, cyanacethydrazide (under a variety of trade names) has been widely used in many parts of the world against lungworm infestations, *e.g.* in pigs (Dick, 1958; Sen *et al.*, 1960), in dogs (Dorrington, 1959), sheep and cattle *vide infra.*

By using a new technique (Walley, 1957a, b) which involved the insertion of a tracheotomy tube into the calf or lamb and attaching the tube to a polythene bag, it was demonstrated that cyanacethydrazide expelled *Dictyocaulus,* etc., alive from the air passages. From this work it appears that for all species the oral dose need not exceed 17.5 mg. per kg. and the subcutaneous dose need not exceed 15 mg. per kg. with a maximum dose of 5 g. for cattle and 1 g. for sheep, goats and pigs. A single treatment removes the majority of worms (65 per cent. to 100 per cent.) but animals severely infected should be treated on each of 3 successive days. The high anthelmintic action of cyanacethydrazide has been confirmed by Vodrazka *et al.* (1960) who, by using a technique involving total tracheotomy, performed really critical anthelmintic tests to estimate the precise effect of subcutaneous injection of cyanacethydrazide in 10 per cent. solution at various dose rates against *D. filaria* in sheep. In summary, they found that (a) 15 mg. per kg. once—79.5 per cent. effective in 15 sheep, (b) 15 mg. per kg. on 3 successive days—93.7 per cent. effective in 39 sheep, (c) 30 mg. per kg. once—76.5 per cent. effective in 8 sheep which had previously had antimony treatment, and (d) 40 mg. per kg. once—98.3 per cent. effective in 9 sheep. In individual animals where the workers recorded a relatively poor effect they noted the associated extensive consolidation of the lung tissue and this is as expected from the original work in sheep, pigs and cattle, where it was recorded (Walley, 1957a, b) that the majority of worms are expelled if there is no mechanical obstruction to their passage up the respiratory tract. If such obstruction is present, then the worms recover from the action of the drug and there is no risk of secondary reaction set up by the presence of dead worms in the lungs.

Vodrazka *et al.* also report that the efficiency of cyanacethydrazide against immature *Dictyocaulus* was estimated to be about 10 per cent. less than against adults judging by the numbers found in the bags and at *post-mortem* examination.

It was shown (Walley, 1957a) that cyanacethydrazide is without action against the migrating *Dictyocaulus* larvae and in calves this is confirmed by Rubin (1959) who treated experimentally infected calves and compared the total number of worms recovered at slaughter in the treated and the untreated groups 2 to 3 weeks after treatment. Rubin found that cyanacethydrazide was (a) ineffective when given 14 days after exposure to infection, (b) moderately effective when given 20 to 21 days after infection and (c) caused considerable reduction in worms when treatment was given 5 days after patency.

Vodrazka *et al.* (1960) compared the efficacy of cyanacethydrazide with other anthelmintics. Their results indicated that 0.4 ml. per kg. Lugol's solution intratracheally was about 25 per cent. as active as cyanacethydrazide and so was a single intramuscular injection of diethylcarbamazine at the rate of 50 mg. per kg. in 10 per cent. solution. Antimosan had no effect against lungworms. These observations confirm our own results which showed the marked anthelmintic superiority of cyanacethydrazide over stibophene and diethylcarbamazine against lungworms in guinea-pigs, sheep, goats and cattle.

Cyanacethydrazide may be considered as being specific for lungworms. No obvious effects on other parasites have been recorded. Following the original observations, extensive combined use of cyanacethydrazide against lungworms with phenothiazine (in cattle and sheep) or piperazine (in pigs) against intestinal worms has shown that full doses of both drugs can be effectively given simultaneously without toxic symptoms. The combination with phenothiazine is useful against lungworms in that the phenothiazine kills the first-stage *Dictyocaulus* larvae while in contact with them in the gut or faeces. Many larvae are released when the worms which have been expelled from the gut break up in the gut.

Since the introduction of cyanacethydrazide as an anthelmintic in lungworm disease, we have shown that its use in 18 artificially infected and 67 naturally infected cattle did not interfere with the development of the natural immunity in the animal. This is confirmed from use in the field. More recently we have shown that cyanacethydrazide will expel those worms which may reach the lungs following vaccination with irradiated infective larvae. From 5 animals, 3, 5, 17, 62 and 71, *Dictyocaulus* were expelled and collected by the technique previously described. The fact that vaccinated calves after exposure to natural infection can develop patent infections and thus act as carriers in transmitting infection from one pasture to another was reported by Cornwell (Cornwell, 1959; Cornwell & Berry, 1960). The present scheme of vaccination,

therefore, may require supplementation by therapeutic means for the more effective control of lungworm disease.

Use of Cyanacethydrazide for Treatment

Experience in the field in cases where "husk" was actually present *or* suspected has, by the nature of cyanacethydrazide being a specific anthelmintic, given rise to reports on the one hand of excellent results, and on the other that the drug is useless.

In parasitised animals where a very heavy larval infestation has severely damaged the lung while the larvae were in the pre-patent phase or where intercurrent disease has caused too much damage, the drug cannot perform a miracle, and under these circumstances cyanacethydrazide or any other anthelmintic will be largely ineffective. Such severely ill animals could not improve clinically (Walley, 1957b; Enigk *et al.*, 1958; Enigk & Federmann, 1958).

Treatment during the early patent phase to remove the lungworms has been shown to prevent the pathological changes caused by the presence of worms, their eggs and the larvae. With treatment during this period the improvement in the clinical condition is most marked. The reduction and easing of the respiratory rate is particularly noticeable. Early treatment of animals has shown that in cattle, sheep and pigs the rate of live-weight gain and efficiency of food conversion was increased (Walley, 1957b). In the latter stages of the disease the worms are also effectively removed by cyanacethydrazide, but the natural recovery of the lungs takes longer.

In trials on naturally infected animals where the parasitic level was determined at the time of treatment and during the post-treatment period workers have recorded their results. Rodriguez Hernandoz (1958) treated 17 young cattle with "Dictycide" (a 25 per cent. solution of cyanacethydrazide), and the author refers to the treatment as having been most satisfactory, and he discusses the use of "Dictycide" and appropriate hygienic measures for the control of lungworm disease in calves. Zettl (1959) treated 178 cattle in 6 herds with a single dose of cyanacethydrazide with good results except that one or two animals continued coughing for some weeks. The largest herd of 80 animals which had a chronic infection were slower to improve in health but did gain in weight during the weeks after treatment.

At the Veterinary College of Hanover, Germany, Rosenberger and Heeschen (1959) carried out a clinical trial of "Dictycide" and "Helmox" in about 400 cattle contained in 16 herds. "Helmox" was used for the treatment of 208 cattle and "Dictycide" for 200 cattle. The active agent, cyanacethydrazide, was administered on 3 consecutive days in dosage each day of 17.5 mg. per kg. for "Helmox" and 20 mg. per kg. for "Dictycide" with a maximum daily dose of 6 g. The results clearly showed the advantage of treatment by the reduction in the degree of larval secretion after treatment, particularly in animals not very severely affected with lungworm disease. On the other hand, Enigk *et al.* (1958) found only a moderate clinical improvement 2 weeks after treatment of the more lightly affected animals, and here the faecal larval count was not reduced. Further experiments in cattle (Enigk & Federmann, 1958) comprised the administration of cyanacethydrazide on 3 successive days after which the number of larvae reduced considerably but returned to one-third or half the original amount in 9 days.

Swanson *et al.* (1959) in field and laboratory trials "revealed no consistencies in regard to the values of the treatment." The figures given are difficult to understand when, for example, (a) 50,000 larvae killed 2 calves but only produced 23 adult worms in a third control, and (b) "30,000 to 33,000 larvae established marked infections without death losses," which is quite inconsistent with the experience of other workers (*e.g.* Jarrett *et al.*) who use only 5,000 larvae to establish this type of infection and regard 10,000 as lethal. However, there is evidence of anthelmintic efficacy from their laboratory work. From the field cases reported the insignificant number of lungworms present at autopsy suggests that the pathological and clinical conditions were caused by some other disease condition and cyanacethydrazide would have no action.

Comyn and Touratier (1958) report that in 150 cattle, treated with 15 mg. per kg. subcutaneously, sometimes once, sometimes twice, at intervals of 5, 8 or 10 days, no tangible result was produced, except some improvement during the month of July. Under similar conditions in France, Gregoire *et al.* (1958) treated 90 heifers with "contradictory" results, whilst a very early treatment of 10 animals at the beginning of the patent phase gave excellent results. Baxter (1957) gave cyanacethydrazide once a week on two occasions to 2 groups of cattle and three occasions to one group of cattle at approximately 16 mg. per kg. bodyweight. The cattle were not severely affected, with one exception, when treatment was commenced. No distinction could be made clinically (no levels of parasitic burden were made) between the treated and the untreated animals of each group when the course of injections was completed. On the other hand, O'Donoghue (1958) used cyanacethydrazide by injection in a herd of 10 calves clinically affected with lungworm disease, unthrifty, and one not expected to survive. Treatment was given on days 1, 7 and 21. Three days following the initial dose all 10 calves showed a marked increase in appetite and coughing disappeared shortly after the second treatment. Six weeks later all animals (some treated orally and some subcutaneously) were free of symptoms and were apparently normal calves. In the previous 4 years in this herd not a single replacement heifer had been raised due to deaths and stunting from lungworm disease.

Jackson (1958) Lawrence (1958) and Trace (1958) record that losses from lungworms were stopped by "Dictycide" (cyanacethydrazide).

In addition to the numerous reports on the therapeutic activity reviewed above, since 1957 many thousands of cattle, including adult animals, have been treated with cyanacethydrazide and the overall results have been good. Dose for dose subcutaneous treatment is slightly more efficacious than oral treatment.

The limitations of a specific anthelmintic have been referred to and in the lungworm field there is

no more active drug. We have shown that diethylcarbamazine is about 25 per cent. as effective as an anthelmintic as cyanacethydrazide, and its use in experimental and natural infections with *D. viviparus* is again limited. The results for cattle in the 3 published papers confirm this. Parker (1957) reported that in a natural outbreak of "husk," where the calves had been coughing for at least 6 weeks, oral dosage of diethylcarbamazine at the rate of 1 mg. per lb. prevented deaths from parasitic bronchitis in 37 calves, 9 to 12 months old. Later it was reported (Parker & Roberts, 1958) that, although intramuscular administration is slightly superior to the oral route, doses of 1 mg. per lb. intramuscularly were ineffective against a moderate experimental parasitic infestation in 4 calves. Against this level of infection 10 mg. per lb. bodyweight, either orally or intramuscularly, to each of 4 calves for 5 days commencing 14 days after infection markedly reduced the faecal larval output of the calves. An immediate clinical response was observed but quite extensive lung lesions were found in both treated and untreated calves at *post-mortem* 82 days after infection. In experiments with controlled worm infestation in calves under 5 months of age, Parker (1957) found that 25 mg. per kg. orally daily for 5 days given 14 to 18 days after heavy infestation prevented deaths and the calves made reasonable weight gains. Treatment of less heavily infested calves on the 27th day "proved quite useless." Later (Parker *et al.*, 1959), in 3 controlled field trials in which a total of 60 yearling cattle were treated by intramuscular injection of a 10 per cent. to 12 per cent. solution of diethylcarbamazine citrate at the rate of 10 mg. per lb. on each of 3 successive days, it was recorded that significant weight gain responses were obtained in 2 outbreaks, in one accompanied by marked clinical improvement and depression of faecal larvae. The latter was the only effect in the third outbreak which was more chronic and said to be seriously complicated by "virus pneumonia."

The evidence to date shows cyanacethydrazide to be the anthelmintic of choice against lungworms resident in the air passages.

Use of Cyanacethydrazide for Prevention

The control of parasitic bronchitis is difficult due to the complex nature of the disease. Any drug which acts only on fifth-stage larvae and adults can have no effect on those histopathological changes which are brought about by the passage of the larvae through the lung tissue. Obviously, also, it can have only a limited effect on the clinical disease in those cases of parasitic bronchitis in the semi-immune animal in which adults and fifth-stage larvae, where, if present at all, are only found in the air passages in very small numbers.

It is evident that the adverse reports on treatment which have so far been published are largely based on the treatment of animals in which considerable tissue damage had been caused by the pre-patent stages of the larvae. It may be significant that so far no adverse reports have been published in the case of *D. filaria* infections in sheep (Walley, 1957a, b; Dorrington, 1958; O'Donoghue, 1958; Guilhon & Petit, 1958; Enigk & Federmann, 1958; Duwel, 1958; Hollo & Kassai, 1958; Mohi-ud-din, 1959; Heipe *et al.*, 1959; and Jordan, 1960), a condition in which tissue damage due to larvae seems to be considerably less than in the case of *D. viviparus*. Also, although no clinical effect may be observed at the time of dosing heavily parasitised animals, we know that the return to health of the affected animal is much more rapid in treated than untreated animals even though there has been no observable improvement within a week or so of dosing.

In the case of calves treated during the lungworm season without obvious benefit, a substantially better condition has been noticed and recorded the following spring in treated, compared with untreated, animals.

The very nature of a natural infection means that until a natural full immunity has developed, and this may take at least 10 weeks, repeat treatment with anthelmintic may be necessary to remove adults as they develop in the air passages.

It would appear that considerable benefit may be obtained from the use of cyanacethydrazide in the prevention of the disease as shown by Harrow's (1959) observations on 25 infected farms known to have a past history of parasitic bronchitis, and in which deaths from the disease were known to occur. On these farms some 589 calves received a regular monthly administration of cyanacethydrazide. Calves were dosed twice, three or four times according to the age at which they went out to grass at monthly intervals from May, June, July or August until September. In 2 groups only a minor outbreak of bronchitis was noted, and in each of these a few animals had been left undosed. One of these outbreaks responded immediately to cyanacethydrazide treatment and the other was too mild to require attention. The remaining groups stayed entirely free of the disease and, from our knowledge of the incidence of the disease in 1958, it seems unlikely that it would not have appeared on at least one or more of these farms. These observations are to some extent confirmed by Gregoire *et al.* (1958) who treated 64 out of a total of 184 young cattle and one month later clinical symptoms of parasitic bronchitis appeared in nearly all animals in both groups, but the treated animals had only mild symptoms, whilst those untreated were severely ill.

In a further trial in 1959, attempting to confirm his earlier report, Harrow (1960) observed the effect of repeated monthly dosing with cyanacethydrazide on 2,086 animals in 76 groups on 59 farms, all of which had a continuous history of clinical lungworm disease over the previous 5 years. No coughing was observed in 22 groups and it was only serious enough to require treatment in 25 of the others. There were a few fatalities in 3 groups, but in 2 of these bacterial pneumonia with very few lungworms was found on laboratory examination.

An interesting point was that 112 of 201 (50 per cent.) of "set-stocked" animals, but only 186 of 531 (28 per cent.) of rotationally-grazed animals were sufficiently affected to require treatment. According to Michel's (1956) observations, which have been amply confirmed in practice, this is the opposite to what might be expected, since rotational grazing

of undosed animals prevents their acquiring effective immunity. Set stocking, on the other hand, provided that there are no disturbing influences, may be expected to enable animals to develop an immunity which keeps pace with the rise in pasture infestation which they build up.

The unusual weather conditions in the summer of 1959, however, made interpretation of such results difficult. Long dry spells prevented the build up of infection on the pasture, but also prevented the acquiring of a natural immunity.

There are two possible explanations to the mode of action of cyanacethydrazide used prophylactically.

The first is that the monthly administration of the drug "cures" incipient clinical outbreaks of the disease before they become apparent. This, however, seems most unlikely since invading larvae are likely to give rise to symptoms before they reach the patent stage and therefore susceptible to the action of the drug. The alternative possibility may be based on the observations of Michel (1956). These show that the level of herbage infestation over the first 9 days determines the fate of the calf no matter what changes in herbage infestation may occur thereafter. If the mean level of the herbage infestation to which the calf is exposed is less than one larva per pound during the first 9 days, the infection will become patent but the calf will survive; if it is between 1 and 3 larvae per pound, the infection will become patent and the calf will die; if the count is above 3 larvae, the calf will die in the minimum period of 19 to 23 days in a Fog-Fever-like syndrome. If the calf is exposed to a pasture carrying one larva per pound of herbage or less, it will, according to Michel, rapidly increase this number as soon as the larvae first picked up become mature and the resultant adults begin to lay eggs. However, if the calf is dosed with cyanacethydrazide 4 to 5 weeks after it is put out, the first generation of adults will be removed and thus the pasture level of larvae may be kept down to a sub-infective level. A further dose or two at monthly intervals may keep it so. It will thus be less dangerous to non-immune calves or other animals which may be put on the pasture later, and which would otherwise receive a pathogenic dose. At the same time, because the calf is continuously exposed to a certain level of larval intake, it can still build up an immunity. Jarrett *et al.* (1957), have noted that an intake of 300 larvae on each alternate day for a period of 2 months has resulted in resistance to a reinfection with a challenge dose of 15,000 larvae.

Toxicity in the Field

A full report on safe administration was given in the original reports (Walley, 1957a, b; Groves, 1958). Few cases of accidental over-dosing outside the therapeutic ratio have been recorded. Pyridoxine hydrochloride (vitamin B_6) is the antidote, and with a lesser degree of success anticonvulsants and anaesthetics have proved effective in such cases.

One of the practical difficulties of cyanacethydra zide by injection is that the solution has to be freshly prepared. The formulation of "Dictycide," whilst ensuring that overdosing by too concentrated a solution is unlikely, is often inconvenient for field work due to the fact that warm sterile water has to be injected into the bottle to prepare the 25 per cent. solution.

References

ASSEN, H. VON DER (1959). *Tierärztl. Umschau.* **14.** 314.
BAXTER, J. T. (1957). *Vet. Rec.* **69.** 870.
COMYN, M., & TOURATIER, L. (1958). *Bull. Vet. Pratique.* November.
CORNWELL, R. L. (1959). *Vet. Rec.* **71.** 562.
———, & BERRY, J. (1960). *Ibid.* **72.** 595.
DICK, J. R. (1958). *Vet. Med.* **53.** 413.
DORRINGTON, J. E. (1958). *J.S.A.V.M.A.* **29.** 63.
———. (1959). *Ibid.* **30.** 27.
ENIGK, K., & DUWEL, D. (1959). *Dtsch. tierärztl. Wschr.* **66.** 379.
———, ———, & FEDERMANN, M. (1958). *Ibid.* **5.** 122.
———, & FEDERMANN, M. (1958). *Monatsh. Vet. Med.* **13.** 705.
GREGOIRE, C., POUPLARD, L., COTTELEER, C., SCHYNS, P., & THOMAS, J. (1958). *Ann. Met. Vet.* **102.** 435.
GROVES, T. W. (1958). *Vet. Rec.* **70.** 219.
GUILHON, J., & PETIT, J. P. (1958). *Bull. Acad. Vet.*, France. **31.** 355.
HARROW, W. T. (1959). *Vet. Rec.* **71.** 223.
———. (1960). Personal communication.
HIEPE, T., HEIDE, D., & LIPPMANN, R. (1959). *Berl. Münch. tierärztl. Wschr.* **72.** 315.
HOLLO, F., & KASSAI, T. (1959). *Magyar Allatorvosok Lapja.* **6.** 184.
JACKSON, R. A. (1958). *Calif. Vet.* **11.** 20.
JARRETT, W. F. H., MCINTYRE, W. I. M., & URQUHART, G. M. (1957). *J. Path. Bact.* **73.** 183.
JORDAN, H. E. (1960). *J. Amer. Vet. Med. Assoc.* **136.** 508.
LAWRENCE, W. R. (1958). *Georgia Vet.* **10.** 9.
MICHEL, J. F. (1956). *Vet. Rec.* **68.** 706.
MOHI-UD-DIN, G. (1959). *Indian Vet. J.* **36.** 335.
O'DONOGHUE, J. G. (1958). *Canad. J. Comp. Path.* **28.** 11.
———. (1958). *Ibid.* **22.** 327.
PARKER, W. H. (1957). *J. comp. Path.* **67.** 251.
———, & ROBERTS, H. E. (1958). *Ibid.* **68.** 402.
———, ———, VALLELY, T. F., & BROWN, F. T. (1959). *Vet. Rec.* **71.** 509.
RODRIGUEZ HERNANDEZ, J. E. (1958). Doctorate Thesis—Central University of Venezuela, Maracay.
ROSENBERGER, G., & HEESCHEN, W. (1959). *Dtsch. Tierärztl. Wschr.* **66.** 169.
RUBIN, R. (1959). *J. Parasit.* **45.** 4, Sect. 2. 57.
SEN, H. G., KELLY, G. W., & OLSEN, L. S. (1960). *J. Amer. Vet. Med. Assoc.* **136.** 366.
SWANSON, L. E., WADE, A. E., SENSEMAN, V. F., & DJAFAR, M. I. (1959). *Amer. J. Vet. Res.* **20.** 777.
TRACE, J. C. (1958). *Calif. Vet.* **11.** 19.
VODRAZKA, J. (1960). *Vet. Rec.* **72.** 404 (Part I).
———, SOKOL, J., & BERECKY, I. (1960). *Ibid.* **72.** 405 (Part II).
WALLEY, J. K. (1957a). *Ibid.* **69.** 815, 850.
———. (1957b). *J.A.V.M.A.* **131.** 539.
ZETTL, K. (1959). *Dtsch. Tierärztl Wschr.* **66.** 319.

THE UNIVERSITY OF LIVERPOOL

The Departments of Veterinary Anatomy and Veterinary Pathology will be vacating their old premises in Bedford Street North, and will move into the new veterinary building which is nearing completion during the month of December.

The Department of Veterinary Pathology announces that it will be unable to accept material for examination between the dates of December 5th, 1960, and January 7th, 1961.

(3) Observations on Husk in Calves due to *Dictyocaulus viviparus* Infestation with Special Reference to the Therapeutic Use of Diethylcarbamazine

BY

W. H. PARKER and T. F. VALLELY

Veterinary Investigation Centre, Wolverhampton

SUMMARY.—In several experiments, both with naturally and artificially infested calves, diethylcarbamazine has been found effective in treating husk. The standard treatment is 3 daily doses of 10 mg. per lb. but in the most recent work a single dose of 20 mg. per lb. has proved almost as effective. There is a very wide toxic margin and the drug is perfectly safe in therapeutic doses. Attempts to compare diethylcarbamazine with cyanacethydrazide have not been successful. The difficulties in diagnosing husk, particularly in differentiating from epidemic broncho-pneumonia, are pointed out. Prognosis, too, is difficult in the absence of an effective form of treatment.

DURING the course of intensive research carried out in the years following the war when large numbers of allied susceptible troops were exposed to infection in the Far East, diethylcarbamazine was found to be highly effective against human filiariasis. The literature is well reviewed by Hawking (1955). An opportunity to test this drug against lungworms in cattle arose in 1953 when a severe outbreak of husk was encountered on a predominantly arable farm in a group of 82 calves, 6 to 9 months old. They had been outside for 3 to 4 months and had been coughing for at least 6 weeks. Four had just died, on which diagnosis was confirmed by *post-mortem* examination, and 4 others were sinking fast.

The remaining 74 calves were divided at random into 2 equal groups. The members of one group received an oral dose of approximately 1 mg. of diethylcarbamazine per lb. weight, while the others were left as untreated controls. Half of the dosed group—again divided at random—were given a second dose at the same rate a fortnight later. All the treated calves survived, but 11 of the controls died or were destroyed on humanitarian grounds. No benefit was attributed to the second dose. This was a preliminary trial arranged at short notice. No larval counts or weighings were possible. The spectacular result was wholly unexpected and led to more searching experiments.

Experiments with Artificially Infested Calves

From 1954 onwards several experiments have been carried out with artificially infested calves and only a general review of the work already published (Parker 1957; Parker & Roberts 1958) will be given here.

The contrast between the naturally-produced and artificially-produced disease is generally much greater in a parasitic disease where multiplication does not take place in the host, than in a bacterial disease. With a bacterial disease a very small dose may, due to multiplication within the host, give rise to vast numbers of the organism, and a severe, even fatal outbreak of disease may follow. In the case of worm infestation the number of worms present cannot exceed the intake and in artificially-infested animals is always found to be considerably less than the number administered. Furthermore, while in artificially-produced disease the worm larvae or bacteria are usually given in one dose, in natural outbreaks of worm infestation the intake is spread over a period of days. This results in worms being present in the lungs in various stages of development. Immunity is built up rapidly in husk (Michel, 1959) and has the effect, characteristic of immunity against worm parasites, of retarding the development of the worms ingested later.

Where worm larvae are all administered at once artificially the worms develop in the lungs very evenly and diethylcarbamazine must be given early to be effective. The standard practice now is to commence treatment 14 days after dosing with larvae. The dose of 1 mg. per lb. used in the preliminary farm experiment was found to be insufficient, and after trying varied forms of dosing it was found that 3 daily doses of 10 mg. per lb. given intramuscularly were effective. The intramuscular route is much easier for administration and is at least as effective as oral dosing. The beneficial effect was manifest by the third day and in more recent work treatment has never exceeded 3 daily doses.

The effectiveness of the drug has been judged by comparison with the controls on the following points.

1. Respiration rates.
2. Weight changes.
3. Faecal larval counts.
4. Lungworm counts.
5. General clinical observations.
6. Death rates.

1. *Respiration rates* of healthy calves are usually in the range of 25 to 40 per minute. The rate rises 5 to 10 days after administration of sufficient numbers of larvae to cause serious disease and the rise is steep up to about the 17th day when it remains high but fluctuating. In calves treated at 14 days the rate commences to fall at once and the contrast with untreated control animals is very marked. Typical figures for the 20th day are 30 to 50 for treated calves against 65 to 100 in the controls.

Even after a period of several weeks the respiration rates of untreated animals remain high because of the damage to the lungs, though the number of worms in the lungs drops rapidly after 5 or 6 weeks, whereas in the treated animals respiration figures tend to revert to normal 1 or 2 weeks after dosing.

2. *Weight changes.* The difference in weight changes between treated and control calves is even more dependent on the severity of the attack than is the difference in respiration rates. There is usually a drop in weight during the second week after larval dosage, but this is reversed as soon as treatment commences, due chiefly to returning appetite. In the controls, provided the attack is not too severe, weight gain returns at a later date and for a period the increase in weight of controls is likely to be greater than that of the treated animals. This must certainly be due to the effect of appetite on the amount of food present in the rumen and the high proportion of bodyweight represented by ruminal contents. Loss of appetite is one of the most characteristic—and most important—clinical signs of husk. The loss of weight of ruminal contents must be an important factor in the loss of bodyweight and the return of appetite in treated or control animals by raising the ruminal weight results in a total rise of bodyweight which would not occur in non-ruminants. In the truest sense of the phrase, it is not a rise of "bodywieght," but it is a highly significant sign of returning health.

3. *Faecal larval counts.* Larvae first appear in the faeces during the fourth week after dosing calves with larvae. The effect of treatment with diethylcarbamazine 14 days after administration of larvae is almost total prevention of larval production while untreated calves may be yielding several hundred larvae per gramme by the end of the fourth week.

4. *Lungworm counts.* The number of worms in the lungs is liable to fall rapidly and in order to get a comparison it is necessary to kill infected calves early. Fig. 1 shows a comparison of worms found in the lungs of 6 calves in our latest experiment, and the contrast between the control calves and those dosed on three successive days is similar to the results of our earlier experiments.

5. *General Clinical Observations.* Calves affected with husk become more docile and lose appetite. The first sign of the benefit of treatment, apparent by the third day, is that the calves are more lively and less easy to handle. There is also a return of appetite and a marked difference in the amount of food consumed compared with the untreated controls.

6. *Death rates.* In experiments designed to produce a severe attack of husk mortality has on occasion reached 100 per cent. in controls whereas no calf treated at 14 days has ever died.

Immunity following Treatment. Experiments have been carried out to test the strength of immunity following treatment by a challenge dose of large numbers of larvae. No effect at all occurred in calves which had recovered naturally, but calves which had previously been treated developed the typical signs of early husk, increased respiratory rates and loss of appetite and weight up to about the 16th day. Rapid recovery then took place and a few larvae only, could be found after repeated examinations of faeces.

Field Trials

The need for field trials of diethylcarbamazine became manifest when it was shown that it was essential to treat experimental husk at an early stage. The difference between the experimental and naturally occurring disease in respect of age and development of larvae has already been pointed out and its importance stressed. The field trials carried out in 1958 (Parker, Roberts, Vallely & Brown) showed that diethylcarbamazine was effective in eliminating adults from the lungs as well as larvae from the faeces and that, provided the drug was given before lung damage was severe, the clinical response was as good as in the artificially infested calves.

Diethylcarbamazine Comparative Dosage Experiment

After initial failures due to inadequate dosage of diethylcarbamazine the trend of dosage in experiments has quite deliberately been towards giving larger doses and more doses than might prove ultimately to be necessary. The observation that calves were rapidly improving by the third day, (which was supported by the experience of several veterinary surgeons using the drug in practice in 1959), led to the decision to try a single dose of 20 mg. per lb. weight against the standard three doses of 10 mg. This experiment has only been carried out this year, and there has, therefore, been no previous reference to it.

Method

As in previous experiments, Ayrshire bull calves were used. They were early-weaned and fed approximately 3½ lb. of rearing nuts per day and hay *ad lib.* When the 21 animals in the experiment were 5½ to 6½ months old they were given 4,000 viable *Dictyocaulus viviparus* larvae by stomach tube. Fourteen days later they were separated into 3 groups of 7. The groups were well-balanced judging by their weekly weight gains over the preceding 7 weeks and by their response to dosage with larvae as indicated by their increased respiratory rates. Treatment by intramuscular injection of a 10 per cent. solution of diethylcarbamazine* commenced at the time of separation, *i.e.* 14 days after administration of larvae. The groups were treated as indicated in Table I.

TABLE 1

Group	Dosage per lb. bodyweight	No. of daily doses
A. 7 calves	20 mg.	1
B. 7 calves	10 mg.	3
C. 7 calves	nil	-

*Franocide, Burroughs Wellcome.

Results

1. *Elimination of lungworms.* One calf in group C died on the 17th day after administration of larvae. Another from group C together with 2 calves from each of the other groups was killed on the 21st day and the worms were extracted from the lungs of all 6. Fig. 1 is a photograph of the worms recovered from the lungs of these 6 calves. Worms were totally absent from the lungs of the calves in group B. There were much fewer worms in the calves from group A than group C but the difference between groups A and B is also considerable. (See art plate facing p. 1067.)

2. *Respiratory Rates.* Fig. 2 shows the average respiratory rates for the 3 groups with a break at the 21st day when 5 were killed for lung examination. Groups B and C follow the usual pattern obtained in earlier experiments for treated and control animals. Group A, on the single dose follows very much the same pattern as group B. In all 3 groups there was a marked rise in the respiratory rate commencing on the 52nd day, following the use of inferior mouldy hay, and respiration rates fell again when this was withdrawn.

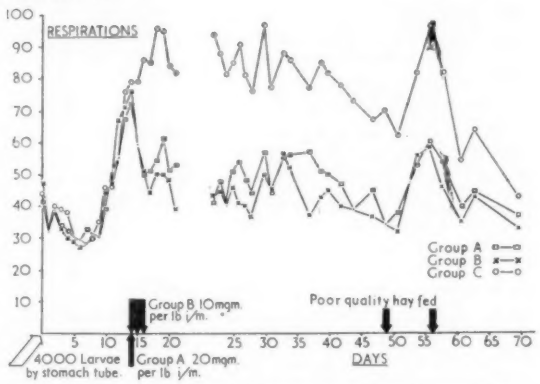


FIG. 2.—Respiration Rates. Comparative Dose Experiment.

3. *Weights.* (Fig. 3.) As in previous experiments the use of a sub-lethal dose of larvae resulted in a check in growth rates in the untreated control group which persisted for a time; then the calves resumed normal weight gains but failed to regain the lost weight, while the treated groups resumed their weight gains immediately after treatment. The animals in group B put on weight at almost the same rate as before they were dosed with worm larvae.

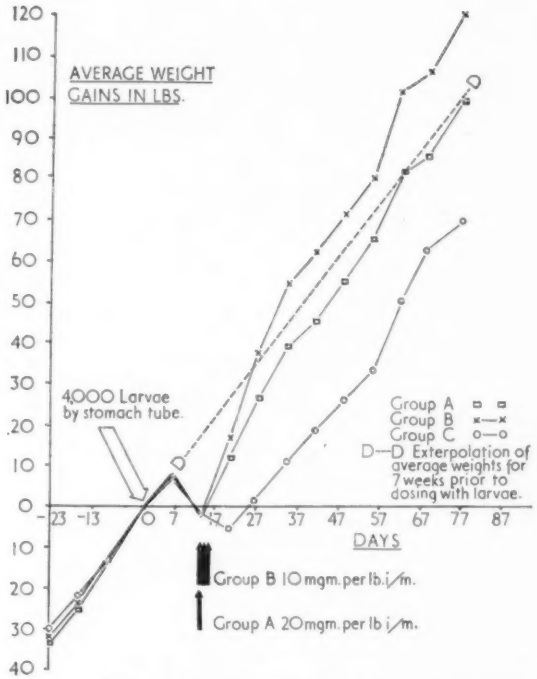

AVERAGE WEIGHT GAINS IN LBS.
4,000 Larvae by stomach tube.
Group A
Group B
Group C
D—D Exterpolation of average weights for 7 weeks prior to dosing with larvae.
DAYS
Group B 10 mgm. per lb. i/m.
Group A 20mgm. per lb i/m.

FIG. 3.—Weight Changes. Comparative Dose Experiment.

4. *Larval output* was too low in groups A and B to be expressed graphically, but Table II shows that the output was very slight in both groups in marked contrast to the control group.

Comparison of Diethylcarbamazine and Cyanacethydrazide

The publication by Walley (1957) of his work with cyanacethydrazide after the preliminary announcement of the experiments with diethylcarbamazine (Rep. An. Health Services. G.B. 1955) led logically

TABLE II
COMPARATIVE DOSE EXPERIMENT
AVERAGE LARVAL COUNTS PER GRAMME OF FAECES

Day	21	23	26	28	30	33	37	40	44	47	51	56
Group A. 5 calves. Single dose 20 mg. per lb....	0·0	0·1	0·9	1·7	0·0	0·9	0·8	0·2	0·0	0·2	0·0	0·0
Group B. 5 calves. 3 doses at 10 mg. per lb. ...	0·0	2·9	1·3	2·7	0·2	0·2	0·1	0·2	0·0	0·0	0·0	0·1
Controls: 5 calves	0·1	18·4	88·5	153·6	155·0	41·6	71·7	71·0	14·5	1·5	0·2	0·1

No larvae were found in any faeces samples on the 62nd and 70th days after oral administration of larvae, the last 2 days of sampling.

to an attempt to compare the two drugs. This is more difficult than is at first apparent. Walley found that cyanacethydrazide was effective against adult worms, whereas diethylcarbamazine is most effective against immature worms. In experiments on artificially infested calves this means that the two drugs would be most effective at different times. An experiment was therefore designed with the intention to administer each drug to a small group of calves at the 14th day (the "ideal" time for diethylcarbamazine) and at the 24th day (assumed to be "ideal" for cyanacethydrazide). The first attempt at this experiment was not a success for while diethylcarbamazine was as usual highly effective at 14 days, and definitely the more effective drug at that time, the calves retained for later treatment were too severely affected for an experiment. Cyanacethydrazide administered subcutaneously on the 14th, 15th and 16th days saved the lives of 3 out of 4 animals treated while the controls died, but it did not prevent the appearance of larvae in the faeces nor lower the respiratory rate as did diethylcarbamazine.

Included in this experiment was a group to test the value of both drugs administered at 7 to 9 days. While such early treatment has no immediate practical significance, it is of interest in considering how the drugs act, particularly diethylcarbamazine, to note that neither drug produced the slightest effect, judged by the usual criteria. Further attempts to compare the drugs in artificially infested calves were abandoned and so far no suitable herd has been found for a field comparison.

The Toxic Margin of Diethylcarbamazine

In an attempt to find out whether diethylcarbamazine would be effective in artificially infested calves 3 to 4 weeks after administration of worms, (*i.e.* at a time when the standard dose was much less effective than at 14 days) a very large dose was given. The most useful information obtained from this experiment concerned toxicity. A dose of 200 mg. per lb. was given to 2 calves intramuscularly and to 4 orally. To give the intramuscular dose a 40 per cent. solution was made. This produced muscle-necrosis and such concentrated doses have not been used since, but there was no systemic reaction attributable to the size of the dose though it was repeated on the second and third day. The oral dose, however, was followed about 4 hours later by nervous symptoms. The calves became excitable; there was twitching and finally they lay down with the head to one side as in a cow with milk fever. No treatment was given but recovery was rapid. Blood samples were taken while still in the resting stage. Calcium values were normal, but magnesium was down to 1.6 mg. per 100 c.c. There were no earlier blood analyses for comporison. The dose was not repeated.

The dose that produced these toxic effects was 20 times the standard dose and 10 times that used in single dosing described in the Comparative Dosage experiment above. As with man the toxic effects were transient even if alarming. The drug is therefore outstandingly safe in usage.

Diagnosis and Differential Diagnosis

The assumption that an epidemic of coughing in calves is pathognomonic of parasitic bronchitis is a fallacy. Neither in laboratory experiments nor in field outbreaks of husk is coughing the most characteristic sign. Abnormally fast breathing is the first sign observed and an occasional light cough may soon follow, but it is not a compulsive cough, and any distraction such as the attention of man will inhibit it. Thus when a group of calves is being examined it is rarely that one of the calves in the foreground coughs; it is most likely to be a calf behind the back of the person making the observation, in fact a calf receiving no attention at the time. In severe cases the respiration rate will reach 110 to 140 per minute, later becoming erratic or laboured and accompanied by an expiratory grunt due to the contraction of abdominal muscles in an effort to evacuate the lungs, much of which will be consolidated or emphysematous. It is only in these later stages that the typical picture is seen, the head extended, the tongue protruded and the expiration vigorous with the whole body concerted in the effort. But as already pointed out by Michel (1959) when this extreme stage is reached, coughing is not frequent. Often the calf lies down at this stage, but the position of the head and the extended tongue remain.

For differential diagnosis it is very important to recognise that these symptoms, particularly the less extreme ones (and these are more commonly seen in practice), are not pathognomonic. Epidemic broncho-pneumonia similar to, or identical with, that described by Jarrett *et al.* (1953) has become widespread in the last 3 to 4 years. At first it seemed to be confined to housed calves and yearlings and as such probably accounts for most of the alleged cases of husk breaking out in housed cattle. So long as this disease was confined to housed cattle differential diagnosis was relatively easy, but in the summer of 1959 quite severe outbreaks of this disease occurred outside. Some veterinary surgeons in practices where husk is a frequent problem have observed that whereas calves with husk rarely cough until driven round the field, calves with epidemic broncho-pneumonia need no such stimulus. Further observations on these lines could be very valuable, but for the present it is essential to accept the fact that it is impossible to make a firm diagnosis of husk without dissecting the lungs. In some cases the disease is sufficiently long established for faecal larval counts to confirm the diagnosis, but a small count is not diagnostic. As outbreaks can be very severe before patency, negative or very low counts cannot be taken as ruling out a diagnosis of husk.

Prognosis

If diagnosis must be considered difficult, prognosis in the absence of effective treatment is much more so. Husk may kill calves which the previous day showed evidence of only moderately severe disease. On the other hand, an outbreak with all the appearance of severity may clear up quite rapidly. The unpredictable nature of outbreaks made it very diffi-

cult to pick suitable herds for field experiments and several attempts were failures because of this. Also it cannot be too highly stressed that observations on and claims for, treatment based on the use of any agent without untreated animals in the same group for comparison are quite misleading. The various treatments of the past undoubtedly owed their popularity to the unpredictable nature of the disease and to man's habitual perversity in preferring to credit improvement to the drug administered rather than the vastly more potent *vis medicatrix naturae!*

A point to bear in mind in prognosis is that outbreaks of epidemic broncho-pneumonia have become so frequent now that occasionally mixed outbreaks occur. In such cases improvement can only be slow even though diethylcarbamazine will deal with the worms. Calves with epidemic broncho-pneumonia do better outside and the only merit in the old-fashioned practice of bringing husking calves in is to feed them better. If the two diseases are present together it is better to treat the calves and leave them outside.

Discussion

Although in artificial experiments timing of treatment is of the greatest importance, this limitation does not apply in natural field outbreaks of husk, in which there appear to be relatively few mature adults as judged by the numbers of larvae excreted which never rise to the very high counts obtained from artificially infested calves. This contrast can be attributed to the arrested development characteristic of the onset of immunity. Diethylcarbamazine, therefore, which is most effective against immature adults and later larval stages of the worm, has a useful field in which to work in natural outbreaks. It prevents the replacement of mature adults which, whether affected by the drug or not, are rapidly passing out of the lungs because of senile decay and the powerful expiratory efforts of the host. Further ingestion of larvae is irrelevant because following a moderately severe attack, immunity will be strong.

There is evidence that the later larval and immature adult stages of the worm are the most damaging parts of its life cycle. Death of the host may easily occur before worms reach maturity (Parker & Roberts 1958; Jarrett *et al.*, 1957), and irretrievable lung damage may result from the presence of such worms. A drug that acts on these early stages before damage is severe will, therefore, be highly effective. Diethylcarbamazine appears to be such a drug.

The practical problems that arise in the field are largely associated with dosage. In deciding on the amount and frequency of any drug it is essential that it shall be adequate in quantity but not toxic. In the use of diethylcarbamazine there is no danger from toxicity. Ever since the effectiveness of this drug was proved the aim of reducing the size and number of doses has been steadily achieved.

In the latest experiment a single dose of 20 mg. per lb. appears adequate judged by the effect on respiratory rates and weight changes. The removal of worms from the lungs was not so complete in the 2 calves killed at 21 days as in the 2 receiving the standard treatment (Fig. 1) but the number of larvae subsequently excreted by the remaining 5 calves in group A were no more than by those in group B. A single intramuscular dose of 20 mg. per lb. can therefore be considered adequate. The intramuscular route is much easier and more accurate than the oral route. Subcutaneous injection would probably be just as effective, but the drug is slightly irritant, and extensive trial by this method would be necessary before it could be recommended with an assurance that there would be no abscess development at the site of injection.

References

HAWKING, F. (1955). *Pharmacol. Rev.* **7.** 297.
JARRETT, W. F. H., MCINTYRE, W. I. M., & URQUHART, G. M. (1953). *Vet. Rec.* **65.** 153.
———. (1957). *J. Path. Bact.* **73.** 183.
MICHEL, J. F. (1959). *J. Roy. Agr. Soc. Eng.* **120.** 28.
PARKER, W. H. (1957). *J. Comp. Path.* **67.** 251.
———, & ROBERTS, H. E. (1958). *Ibid.* **68.** 402.
———, ———, VALLELY, T. F., & BROWN, F. T. (1959). *Vet. Rec.* **71.** 509.
Rep. An. Health Services. G. B. (1955). **77.**
WALLEY, J. K. (1957). *Vet. Rec.* **69.** 815.

TELEVISION REPORT ON FOOT-AND-MOUTH EPIDEMIC

Mr. A. G. Beynon, Deputy Chief Veterinary Officer and junior vice-President of the B.V.A., was interviewed last Sunday by Independent Television News in connexion with the foot-and-mouth epidemic. The interview was broadcast during the six o'clock news bulletin. Asked by the interviewer whether this was the worst outbreak farmers and veterinary surgeons had experienced, he said that it was not; what distinguished this outbreak were the facts that 17 markets had been involved and that control had necessitated the tracing and slaughter of some 17,000 cattle in 60 counties.

Asked whether the outbreak was past its peak, Mr. Beynon replied that he thought so, but that it was not possible to forecast the course of the disease with any degree of confidence. The disease was certainly not out of control, and had been traced, in most areas other than the Midlands, to market infection with a source in the North.

The interviewer then asked why this country did not follow a vaccination policy as was done on the Continent. Mr. Beynon pointed out that the disease is not endemic in this country, and because of our geographical position it was considerably more economical to slaughter infected cattle. He also pointed out that vaccination would prejudice the sale of pedigree cattle from the United Kingdom throughout the world.

The news item concluded with a short interview with a farmer who, having suffered an outbreak of the disease on his farm, was now in favour of the slaughter policy, and with a veterinary officer who was working on the farm, who emphasised the necessity for all those precautions being taken on infected farms and in infected areas.

(4) Recent Experiences with Vaccination

BY

D. POYNTER, B. V. JONES, A. M. R. NELSON, R. PEACOCK, J. ROBINSON, P. H. SILVERMAN, and R. J. TERRY

Allen and Hanburys Ltd., Ware, Herts.

SUMMARY.—Work in guinea-pigs and calves shows that the larvae of Dictyocaulus viviparus *may reach the lung twenty-four hours after infection. Larvae irradiated at* 40,000 *r. also reach the lung but are there suppressed before the development of disease. Migration to the lung also occurs in resistant animals even when infected with irradiated larvae. The lungs and not the mesenteric lymph nodes appear to be the main site of larval suppression.*

Evidence is provided on the safety of the X-irradiated vaccine and the precautions taken to ensure that it does not transmit other diseases. An outline of recent field experiences is provided together with some observations on the complement-fixation test using adult worm antigen. It is emphasised that account must be taken of other respiratory diseases in investigating outbreaks of coughing in calves.

Introduction

The work carried out by the Glasgow Veterinary School team on the development of a vaccine against husk was reported at the 1957 B.V.A. Congress in Cambridge (Jarrett, Jennings, McIntyre, Mulligan and Urquhart, 1957b). Their work led to the development of the first commercially produced vaccine for use against a nematode infection. This was the first practical vaccine to arise out of the expanding interest in parasite immunity.

It is our intention to report in this communication some of the work that our group has undertaken on this method of immunisation against *Dictyocaulus viviparus* infection in cattle, using larvae partially inactivated by X-irradiation. Our veterinary research group commenced in 1957 to work in this field and since that time has devoted a major effort to the commercial development of this vaccine. It is not the purpose of this paper to discuss the production process of the vaccine although this has formed a considerable section of our work. It is sufficient to say that the maintenance of a constant population of calves infected and managed in such a way as to produce an adequate output of larvae without death, coupled with the extraction from the faeces of third stage larvae, has proved to be a considerable undertaking. The final production of these larvae, free of faecal debris, and their subsequent X-irradiation and vialling, together with all the essential control and safety testing procedures, culminating in a final product with a limited shelf life, has also presented many difficulties. The complete process has provided a problem that in our experience has not only been unique but has appeared at times almost insoluble. However, these difficulties have been overcome and in February 1959, the husk vaccine* was launched for commercial sale in the British Isles. We have now produced this vaccine for two seasons and we propose to report some of our observations on parasitic bronchitis and its prevention by immunisation. This has been our first opportunity of presenting these results at a major veterinary meeting and we would like to state that it is our privilege to speak not only for ourselves but also on behalf of our colleagues who have contributed so much to this work.

* Dictol.

The Life Cycle of *Dictyocaulus viviparus*

Soliman (1953) pointed out that information on the development of the parasitic phase of the life cycle of *D. viviparus* was incomplete and that more observations were desirable. His work in guinea pigs using doses of 7,000 infective larvae showed them to be present in the lymphatic glands within 24 hours and in the lungs within 3 days. In 17 field cases of bovine parasitic bronchitis he was able to find larvae in the mesenteric lymph glands of 10. He refers only to finding 3rd stage larvae and, although giving no figures of his recoveries, he states that they were very variable. Jarrett, McIntyre and Urquhart (1957a), in a paper devoted largely to the pathology of husk, stated that it was the 4th stage larvae that left the lymph glands to migrate to the lungs. They infected calves with 5,000, 100,000, and 240,000 larvae, but made no mention of finding lung lesions attributable to the larvae until 5 days later. On the other hand, Douvres and Lucker (1958), working with guinea-pigs, recovered 3rd stage larvae from the lung 18 hours after administering doses between 120,000—450,000 larvae. They were able to study the subsequent morphological changes undergone by these larvae in the guinea-pig lung.

(a) *Experiments in guinea-pigs*

Fate of Normal Larvae

Our preliminary experiments were designed to elucidate the migratory route of the parasite in the guinea-pig. After an investigation of various doses we eventually settled on 5,000 larvae as a practical number with which to work since it gave us reproducible recoveries from the lung. Although we have occasionally had guinea-pigs harbouring *D. viviparus* for as long as a month, it is our general experience that the worms persist in the lung for about 17 days and that they are gradually eliminated by being swept up the trachea. In infecting 113 guinea-pigs with 5,000 *D. viviparus* larvae each we have found the average lung burden at 10 days to be 212.

Table I presents the results of an experiment designed to find where the larvae were within the guinea-pig on any given day. We used for this experiment doses of 200,000 since we wished to con-

TABLE I

THE MIGRATORY ROUTE IN THE GUINEA-PIG

THE TABLE SHOWS THE NUMBERS AND STAGES OF LARVAE RECOVERED FROM THE GIVEN SITES ON THE GIVEN DAYS

Day	Lymph	Heart	Lung and trachea	Gut mucosa	Liver
1	57 L_3	0	14 L_3	2 L_3	0
2	3 L_3	0	124 L_3	0	0
3	0	0	105 L_3 & L_4	0	0
4	0	0	142 L_4	0	0
5	0	0	106 L_4	0	0
6	0	0	338 L_4	0	0
7	0	0	1,183 L_5	0	0
8	0	0	2,345 L_5	0	0
9	0	5 L_5	372 L_5	0	0
10	0	0	668 L_5	0	0

firm that the lymphatic route was utilised and that no liver migration was involved; if any liver migration did occur we would be much more likely to find it at high levels of infection. It will be seen that we found larvae in the lymph nodes on days 1 and 2 but not after this time. We concluded from this experiment that larvae reached the lung within the first day and that no liver migration occurred. It also seemed that gut penetration was rapid. The finding of five larvae in the heart on day 9 is of interest and since the larvae were in the fifth stage we concluded that they had been swept through the pulmonary capillaries into the heart. It might be argued that a liver migration does occur but it is over within 24 hours. However the livers of all our guinea-pigs appeared normal and we conducted a further experiment in which we examined the livers of guinea-pigs at hourly intervals for 8 hours after infection without finding any larvae, or lesions to suggest their passage.

In both guinea-pigs and mice we have repeatedly noted that 24 hours after infection with doses of 2,000—5,000 larvae, the lungs are covered in petechiae. Histological examination has revealed that these lesions are, as might be expected, due to the rupture of capillaries by larvae entering the alveoli. These lesions gradually resolve but are still recognisable at 10 days as small dark brown or grey spots.

As will be seen below, we have often recovered larvae from the guinea-pig lung 24 hours after infection at the 5,000 level. This point is of interest since it might be argued that the finding by Douvres and Lucker (1958) of larvae in the lung at 18 hours was related to the very high level of infection (120,000—450,000) they used and that Soliman's (1953) observation that larvae did not reach the lung until 3 days was related to the modest level (7,000) he employed. Such is not the case.

Consideration will now be given to the effect of irradiation on the life cycle and to the life cycle in the resistant animal. We will first mention observations we have made in guinea-pigs and then discuss the position as shown by experiments we have carried out in calves.

The Fate of Larvae Irradiated at Various Levels

Larvae were irradiated at levels varying from 2,000—40,000 roentgens. The larvae were given to guinea-pigs *per os* at doses of 5,000 each; the results are shown in Fig 1. It will be seen that at ten days when the experiment was concluded there were no worms in the lungs of the guinea-pigs given larvae irradiated at 40,000 r, the level used to make the commercial vaccine. This finding was confirmed by giving each of 30 guinea-pigs 5,000 larvae irradiated at 40,000 r and killing them after ten days: the average number of worms found in the lungs was one. It is apparent then that the level of irradiation employed prevents larval development. However, it was known from preliminary experiments that irradiated larvae could be recovered from the mouse and guinea-pig lung. We therefore carried out a further experiment in which we serially killed guinea-pigs that were given 5,000 larvae each. The larvae given to one group were irradiated and the larvae given the other group were not. The results are shown in Table II. It will be seen that at first the numbers

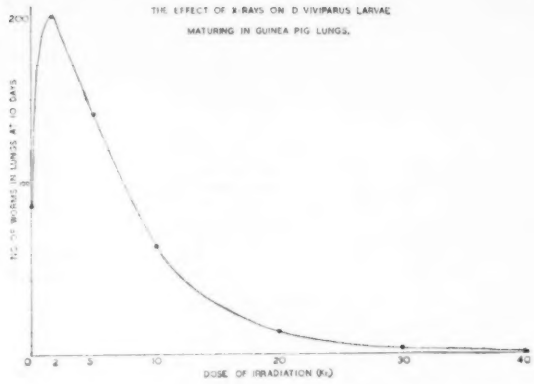


TABLE II

THE NUMBERS OF IRRADIATED (40,000R) AND NORMAL LARVAE RECOVERED FROM GUINEA-PIG LUNGS

Day	Number of larvae in lung		Day	Number of larvae in lung	
	Normal	Irradiated		Normal	Irradiated
1	57 L_3	148 L_3	6	210 L_4+L_5	17 L_4+L_5
2	64 L_3	86 L_3	7	476 L_5	67 L_5
3	94 L_4	2 L_4	8	96 L_5	3 L_5
4	83 L_4	107 L_4	9	197 L_5	0
5	590 L_4	122 L_4	10	363 L_5	0

of larvae found in both groups are similar but that at about days 6—7 there is a sudden marked reduction in the numbers of worms recovered from the group given irradiated larvae with the result that no larvae were recovered on days 9 and 10.

It can be seen that X-irradiation affects *D. viviparus* at, or at least just after, the transition from the 4th to 5th larval stage.

The Resistant Guinea-pig

In order to determine whether or not guinea-pigs become resistant to *D. viviparus* experiments were conducted where guinea-pigs were given immunising

doses of 5,000 larvae these being either irradiated (40 Kr.) or not. The results are shown in Table III and they provide clear evidence of the fact that the ability of irradiated larvae in evoking immunity is equal to that of normal larvae.

TABLE III

COMPARISON BETWEEN THE IMMUNISING ABILITY OF NORMAL AND IRRADIATED LARVAE

Immunised with normal larvae	Immunised with irradiated larvae	Control
0	1	458
0	1	333
0	0	648
2	0	157
3	0	61
–	–	–
5	2	1,657
–	–	–

The guinea-pigs were each given 5,000 larvae either irradiated or not on days 1 and 22.

They were all challenged on day 43 with 5,000 larvae and killed on day 53.

TABLE IV

THE FATE OF LARVAE IN THE RESISTANT AND SUSCEPTIBLE GUINEA-PIG

Day	Number of larvae in lung		Day	Number of larvae in lung	
	Resistant	Susceptible		Resistant	Susceptible
1	80 L_3	66 L_3	7	0	93 L_4
2	37 L_3	140 L_3	8	0	375 L_4
3	18 L_3	139 L_3	9	1 L_5	15 L_5
4	9 L_3	69 L_4	10	0	53 L_5
5	7 L_4	41 L_4	11	0	47 L_5
6	0	136 L_4			

Knowing that guinea-pigs become resistant it was necessary to ask when and where the immunity acted. A group of guinea-pigs was therefore made resistant by giving them two doses of 5,000 larvae each. Twenty-two days after the second immunising dose the guinea-pigs were challenged with 5,000 larvae each together with the appropriate control. The guinea-pigs were killed at daily intervals for 11 days and the results are shown in Table IV. It will be seen that larvae reach the lungs of the resistant guinea-pig but that they are rapidly dealt with and are not recovered in appreciable quantities after day 5. The lymph nodes of the guinea-pigs were also examined, but apart from finding one larva in the resistant guinea-pig killed on day 4 and two in that killed on day 6 the results were negative.

The figures shown in Table IV might be interpreted as showing a reduced number of larvae in the lungs of the resistant guinea-pigs after the first 24 hours. However, it was not felt that the figures had significance in this respect and consequently a similar experiment was performed the results of which are shown in Table V. It will be seen that larvae reach the lungs of susceptible and resistant guinea-pigs in equivalent quantities and that only small numbers are found in the lymph nodes.

It was shown then that larvae reach the lungs of the resistant guinea-pig and are suppressed there. Further experiments were conducted in an effort to discover whether or not the site of larval hold up could be modified according to the degree of resistance afforded to the individual guinea-pigs. A series of immunising doses was consequently given so that groups of guinea-pigs became available that had experienced 1, 2 and 4 previous exposures to 5,000 larvae. These guinea-pigs were each challenged with 5,000 larvae and the number of worms present in the lung at 10 days counted. The results are shown in Table VI. It will be seen that although one previous exposure evokes some immunity this is not absolute. Further there were no observed differences between guinea-pigs receiving two or four previous exposures.

In another experiment guinea-pigs were given 2 and 4 previous exposures. They were killed at daily intervals for 10 days after challenge and careful examination of the gut mucosa and sub-mucosa, lymph nodes and lungs was made. No differences were seen in the recoveries of larvae from such sites and no evidence obtained of larvae being affected

TABLE V

THE FATE OF NORMAL LARVAE IN THE RESISTANT AND SUSCEPTIBLE GUINEA-PIG

Days after challenge	Resistant		Susceptible	
	Number in lungs	Number in lymph nodes	Number in lungs	Number in lymph nodes
1	85 L_3	4 L_3	109 L_3	10 L_3
1	126 L_3	9 L_3	129 L_3	2 L_3
2	73 L_3	0	63 L_3	0
2	73 L_3	1 L_3	49 L_3	0
10	0	0	274 L_4	1 L_4

During the first 48 hours after challenge there was no difference in the larval recoveries but by 10 days no larvae were found in the resistant guinea-pig.

TABLE VI

THE RESISTANCE OF GUINEA-PIGS TO REPEATED DOSES OF LARVAE

Immunising schedule	Challenge	Number in lungs of immune animals	Number in lungs of guinea-pigs (no previous exposure)
I_1—Day 1	Day 58	64	402
I_1—Day 1 I_2—Day 58	Day 68	0	429
I_1—Day 1 I_2—Day 58 I_3—Day 63 I_4—Day 67	Day 77	0	278

The numbers of larvae recovered from the lungs of groups of 5 guinea-pigs each.

The guinea-pigs had experienced previous infections which rendered them immune. They were all killed 10 days after challenge.

TABLE VII

LARVAL RECOVERIES FROM VARIOUS PARTS OF THE GUINEA-PIG BODY

Day	Group A Four previous exposures			Group B Two previous exposures			Group C No previous exposure		
	Lung	Lymph	Intestinal tract	Lung	Lymph	Intestinal tract	Lung	Lymph	Intestinal tract
1	65 L_3	5 L_3	0	112 L_3	24 L_3	1 L_3	182 L_3	41 L_3	0
2	70 L_3	0	0	23 L_3	0	0	129 L_3+L_4	2 L_3	0
3	10 L_3	0	0	17 L_3	0	1	126 L_4	0	1 L_3
4	13 L_4	0	0	2 L_4	0	0	4 L_4	1 L_4	0
5	0	0	0	2 L_4	0	0	42 L_4	0	0
6	0	0	0	0	0	0	188 L_4+L_5	0	0
7	0	0	0	0	0	0	310 L_5	0	0
8	0	0	0	0	0	0	584 L_5	0	0
9	0	0	0	0	0	0	441 L_5	0	0
10	0	0	0	1 L_4	0	0	149 L_5	0	0

The guinea-pigs were killed daily. Even with 4 previous exposures, no evidence of larval hold up or suppression was found at any site other than the lung.

other than in the lung itself. The results are shown in Table VII.

The following facts have emerged from the guinea-pig work:

(i) Larvae reach the lung within 24 hours travelling via the lymph vessels.

(ii) Irradiated larvae (40,000 r) reach the lung at the same rate and in similar numbers to non-irradiated larvae but they are suppressed at about days 6—8.

(iii) Normal larvae reach the lung of the resistant guinea-pig at the same rate and in similar numbers as they do in susceptible guinea-pigs but are not found after 5 days.

(iv) No lymph node hold up was found.

(v) Normal and irradiated larvae produce the same degree of protection.

(b) *Experiments in Calves*

In view of the fact that irradiated larvae reach the guinea-pig lung we decided to carry out experiments in calves. Jarrett *et al.* (1957b) carried out an experiment in which the aim was clearly stated: they wrote, "So we irradiated the pre-migratory stage in an attempt to find a dose of irradiation which would not allow development beyond the invasion of the mesenteric nodes. We started a series of experiments to try to find the dose necessary to do this". The result of this work was that 40,000 r was selected as the dose which fulfilled the above conditions.

We felt the prime necessity was to investigate the rapidity with which the larvae of *D. viviparus* reach the lungs. Soliman (1953) recovered them from the lungs of a rabbit 5 days after infection and from a guinea-pig 3 days after infection; he makes no mention of the numbers of larvae found. It is our experience that larvae reach the lung *via* the lymph and that they are to be found 24 hours after infection. Jarrett *et al.* (1957a) in a paper on the pathology of parasitic bronchitis state that larvae undergo a moult in the mesenteric lymph nodes and pass out of these lymph nodes as 4th stage larvae. They infected calves with 5,000, 100,000 and 240,000 larvae but make no mention of observing lung lesions attributable to the larvae until 5 days after infection.

Table VIII illustrates the results we have obtained by carrying out Baermann recoveries on the lungs and lymph nodes of calves recently infected with larvae.

TABLE VIII

THE FATE OF NORMAL *Dictyocaulus viviparus* LARVAE IN THE SUSCEPTIBLE CALF

Calf number	Larval dose	Time between dose and slaughter	Number of larvae found	
			Lungs	Lymph nodes
1225	200,000	24 hours	4	1
553	200,000	48 ,,	2,608	0
1202	200,000	48 ,,	6	5
1220	200 000	48 ,,	705	905
562	200,000	72 ,,	5,225	0
837	200 000	72 ,,	4,500	0
1226	200,000	72 ,,	320	0
1224	200,000	96 ,,	4,310	0
Total number in lungs ...			17,678 (94 per cent.)	
,, ,, lymph nodes			911 (6 per cent.)	

Even 24 hours after infection we find that the lungs of animals given the high doses of larvae we employed are covered in petechiae and that these lesions are dispersed throughout the lung tissue; the lesions are in fact identical to those seen in the mouse and guinea-pig lung 24 hours after infection. Sections show them to be caused by capillary bleeding into

TABLE IX

THE FATE OF IRRADIATED *Dictyocaulus viviparus* LARVAE (40,000R) IN THE SUSCEPTIBLE CALF

Calf number	Larval dose	Time between dose and slaughter	Number of larvae found	
			Lungs	Lymph nodes
1233	200,000	24 hours	6	1
566	200,000	48 ,,	1,480	50
1232	200,000	48 ,,	185	40
1209	200,000	48 ,,	5	0
1228	200,000	72 ,,	105	0
1231	200,000	96 ,,	255	5
1178	100,000	96 ,,	80	0
1177	100,000	96 ,,	15	0
Total number in lungs ...			2,131 (95 per cent.)	
,, ,, lymph nodes			96 (5 per cent.)	

TABLE X

THE FATE OF NORMAL *Dictyocaulus viviparus* LARVAE IN THE RESISTANT CALF

Calf number	Larval dose	Time between dose and slaughter	Number of larvae found	
			Lungs	Lymph nodes
846	200,000	24 hours	252	283
884	200,000	48 ,,	142	0
97	200,000	48 ,,	455	5
894	200,000	72 ,,	969	0
900	200,000	144 ,,	4,638	1
Total number in lungs ...			6,456 (95 per cent.)	
,, ,, lymph nodes			289 (5 per cent.)	

the alveoli and we believe they mark the point of entry of the lungworm larvae into the air spaces. In the mouse and guinea-pig we have observed larvae in relation to these lesions. We have never seen these lesions in uninjected control calves.

We conclude therefore that the larvae of *D. viviparus* reach the lung, where subsequent development occurs, and that they do not dwell as 4th stage larvae in the lymph nodes. We obtained evidence of the lymphatic migration (Calf 1220) and at the same time carried out Baermann extractions of the livers with consistently negative results.

Table IX shows the results we obtained using irradiated larvae. Once again the lungs were covered in petechiae. Evidence was therefore obtained to show that irradiated larvae reached the lung and no evidence of a mesenteric lymph node hold up was seen.

Table X shows the results obtained using normal larvae in the resistant calf. The use of the term 'resistant' does perhaps require clarification. The calves we used had all withstood a previous infection with 4,000 larvae. Jarrett *et al.* (1957b) state that 4,000 larvae are capable of producing a very strong immunity to reinfection, so that it does not seem unreasonable to regard our calves as resistant. Table X shows similar results to those given in Tables VIII and IX and it seems that even in the resistant animal larvae reach the lungs and are not held up in the mesenteric lymph nodes.

In all the experiments on calves mentioned above large numbers of larvae were used as infective doses and it might be suggested that the results have little relationship to those found in the actual disease. We have however dosed two susceptible calves with 4,000 *D. viviparus* larvae. We killed one calf at 36 hours after dosing and recovered 44 third stage larvae from the lungs; the other calf was killed at 48 hours and 23 larvae were recovered from the lungs. There can then be no doubt that even 36 hours after giving a dose of larvae sufficient to produce the disease as seen in the field, larvae are in the lungs. It is also of note that in our experiments using guinea-pigs we obtained similar results to Douvres and Lucker (1958) in that we found 3rd stage larvae at 24 hours although employing a dose considerably lower than theirs.

We carried out a further experiment on a resistant calf to which we gave 20,000 irradiated larvae in order to determine the role of the mesenteric lymph nodes with regard to larval hold up. If larvae were to be found in these nodes then conditions should be suitable since irradiated larvae were used and the animal had previously experienced husk. The animal was killed 48 hours after dosing. The lung showed the petechiae we had already noticed. The thoracic lymph nodes appeared normal but some of the lymph nodes draining the intestines were haemorrhagic.

A Baermann extraction was carried out on the lung and 3,151 larvae recovered. One half of every lymph gland was teased apart with needles under the dissecting microscope. Fifty-five larvae were found in the thoraric lymph nodes, 15 in the lymph nodes draining the large intestine and 471 in the lymph nodes draining the small intestine; the other halves of the lymph nodes are being sectioned but the results are not yet available. To get an estimate of the total number of larvae in the lymph nodes it is reasonable to multiply our figure of 541 by 2, since we did only tease apart half the lymph nodes. We therefore conclude that there were 1,082 larvae migrating in the lymph nodes. Thus 3,151 larvae had reached the lung and 1,082 had not; it is problematical whether or not these larvae were about to move to the lung or remain and be destroyed in the lymph. In any event this one experiment establishes that the majority of irradiated larvae recovered from the calf had reached the lung within 2 days.

Although we know that irradiated larvae (40,000 r) reach the lung it is also known (Jarrett *et al.* 1957b) that at 30 days the lungs are relatively clear of worms. It seems then that X-irradiation affects larvae in the lungs and hinders normal adult development. The results obtained in guinea-pigs have already been presented, here there is a suppression at or just after the transition between the 4th and 5th stages so that few worms are present after 7 days. It is likely that a similar state of affairs is seen in the calf.

Investigations on the Safety of the Irradiated Vaccine

It is obvious that with any oral vaccine, in particular one of a new type, these are two important aspects of safety which must be considered. These fall under two general headings, namely, the possibility of the vaccine producing parasitic bronchitis and its freedom from contamination with other pathogenic organisms. The investigations that we have undertaken fall into three main groups.

(a) The possibility of the vaccine producing husk.

(b) The bacteriological testing of production calves and larvae obtained from these calves.

(c) The administration of vaccine to normal calves and the prolonged clinical observation and eventual *post-mortem* examination of these animals to ascertain whether or not they remain disease free.

(a) *The possiblity of the vaccine producing husk*

In order to make certain that the vaccine was safe we conducted a trial in which we subjected larvae to 30,000 and 50,000 r and administered these larvae to calves at dosages of 250, 1,000, 4,000 or 16,000.

TABLE XI

ESTIMATES OF THE AMOUNT OF LUNG DAMAGE SEEN IN CALVES 16 DAYS AFTER INFECTION WITH *D. viviparus* LARVAE IN THE QUANTITIES AND AT THE IRRADIATION LEVELS SHOWN. THE NUMBERS SHOWN ARE AN ASSESSMENT OF LUNG DAMAGE WHERE 10 DENOTES 75 PER CENT. CONSOLIDATION OF THE LUNG

Number of larvae given	30,000r	50,000r	Nil irradiation
250	0	0	3
1 000	0	1	4
4,000	2	1	6
16,000	2	2	10

Similar larvae were not irradiated and were given to calves as controls. All the calves were killed 16 days after dosing.

Table XI shows an estimate of the amount of lung damage seen in the individual calves; the effect of X-irradiation in reducing or eliminating lung damage is apparent. It will also be seen that once the number of larvae given is raised to 4,000 or over some lung damage occurs and this fact shows that irradiated larvae do reach the lung both at 30,000 and 50,000 roentgens.

We carried out a further trial in which 12 calves were dosed with the standard vaccine (1,000 larvae irradiated at 40,000 r) and 5 calves were each dosed with non-irradiated larvae. Clinical examinations were made on all calves on 3 days per week. All 12 vaccinates remained normal clinically; their rates of respiration were within normal limits (Fig. 2) and their breathing was of the "harsh vesicular inspiration" type. Each calf dosed with 1,000 normal larvae showed an elevated respiratory rate accompanied by broncho-vesicular breathing.

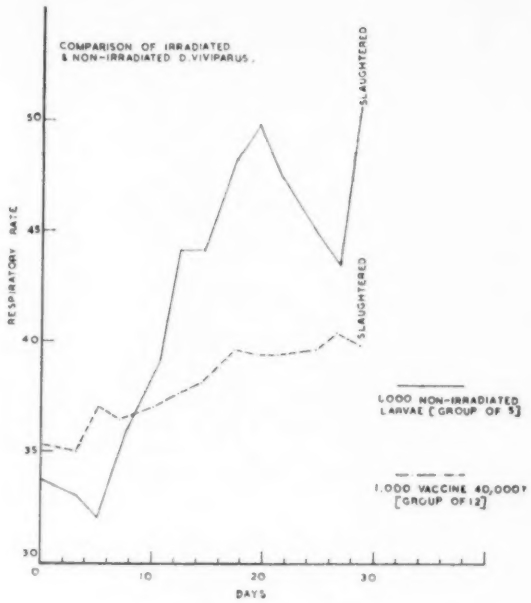
Thirty days after infection the calves were slaughtered. The lungs from the 12 vaccinates were macroscopically normal. Histological examination showed what could be interpreted as alveolar collapse and in one section eosinophils were seen migrating through the bronchiolar epithelium. Some evidence of "cuffing" pneumonia was also seen. In some of the sections pus was present in the bronchioles. However, the lesions seen were minimal and were isolated to individual lobules and not spread generally throughout the lung.

The lungs from the control calves showed areas of consolidation involving from 12%—25% of the lung. Sections cut from affected areas showed typical husk lesions.

Adult worms were found in 4 out of the 12 vaccinates; the mean number of worms per calf was 1.0. All 5 controls had adult worms in their lungs; the mean number of worms per calf was 37.6.

(b) *Bacteriological testing*

It is not intended to discuss here in full the procedures undertaken for the bacteriological testing of production calves and of the vaccine, except to say that rigorous testing procedures are operated several times during the production process on both calves and vaccine to ensure an absence of *Salmonella spp., Brucella abortus, Mycobacterium tuberculosis* and *M. johnei*. At the same time every animal associated with the process is inspected daily for the presence



of viral and other diseases. Together with this, general hygienic and other precautions to ensure both the health of the animals and that of the workers involved in production are in operation.

(c) *Safety testing in calves*

During the course of production we perform extensive testing procedures on the safety of the vaccine. We can report now on observations made on 62 calves, all having passed tests for freedom from brucellosis, salmonellosis, Johne's disease, and tuberculosis, which have received single doses of 1,000 irradiated larvae from 31 different production batches; the calves were dosed and housed in pairs. These calves were kept in isolation for a period of 8 weeks and daily clinical examination conducted. They were then again tested for brucellosis, salmonellosis, Johne's disease, and tuberculosis, after which they were slaughtered. Retropharyngeal, duodenal, and ileo-caecal, lymph nodes were cultured for evidence of *M. johnei*, and all lungs carefully dissected and examined histologically. The results obtained from these 62 calves, and also the results of a later series in progress now, have been extremely satisfactory. There has been no evidence, either clinically or at post-mortem examination, that the vaccine has in any way acted as a vehicle for transmitting any of the 4 bacterial diseases mentioned above. At post-mortem examination 3 calves were found with adult worms in their lungs; the numbers were however very low, being 3, 9 and 13 respectively. Two of these calves received material from the same production batch. There were occasional cases of clinical pneumonia suspected in some cases of being cuffing, pneumonia, but this was not always demonstrated post-mortem. The onset of these symptoms could not be related to the administration of the vaccine, and in those cases where it occurred could not be correlated

with other calves receiving the same material. The incidence of cuffing pneumonia in these calves was comparable to that seen in calves of the same age that had not received the vaccine.

The Complement Fixation Test Using Adult Worm Antigen

The technique used for this test is essentially similar to that employed by Jarrett *et al.* (1959). It is not proposed at this point to go into the details of experiments we have performed using the test since these will form part of a separate communication; the main conclusions we have reached will however be mentioned.

We find that there is little rise in titre (KSA/KS) during the 4 weeks after 1st vaccination. The rise after the second vaccination is variable. The titres of some calves rise quickly within 1 week but others take longer and do not reach the same height. After challenge almost all calves show a very rapid increase to a higher level than that seen after vaccination.

In older animals titre rises are faster and reach greater heights than those seen in younger calves.

If the vaccine is given to previously infected animals a typical secondary response is seen.

The relationship of the CF titre and the actual immunity of a given animal is not absolute. Immunity may develop before a rise in the CF titre and may persist strongly as the CF titre is falling as has been noticed in hyper-immune animals.

The CF titre may be useful in the diagnosis of lungworm infections from other respiratory diseases but with the present state of our knowledge it is necessary to have serial readings and relate these to the general background.

Field Experiences With Vaccination

During 1959, many tens of thousands of courses of lungworm vaccine* were distributed commercially to veterinary surgeons in the British Isles. Following its administration in the field, a number of enquiries were received concerning either the safety or efficacy of the vaccine. It is appreciated that the enquiries received may not have represented absolutely the overall picture but, because of the relatively high cost and the novelty of this type of vaccination compared with other vaccines, it is felt that virtually all complaints, at least those where there was any substance in the farmer's or veterinary surgeon's observations, were reported to us. It would also appear that due to these same reasons the vaccine was used almost exclusively on farms with a previous history of husk.

All the reports received were investigated. In most cases this was by personal visit and in several by more than one visit (Jones and Nelson, 1960). In no case was any relationship found between these reports and any specific batch of vaccine, each batch size usually being several thousand doses.

Of these enquiries a few were associated with reactions after vaccination seen during the first 2 weeks after either dose. These reactions consisted of slight transient coughing which rapidly resolved. The number of these was not significant. Other "reactions" reported ranged from fractures to all the common calf ailments and their relationship to vaccination can, at best, be only problematical. Other enquiries were associated with vaccinated calves at various times after being turned out to pasture; frequently these enquiries arose at the time the calves were meeting a husk challenge. In only 16 farms out of a total of about 4,000 farms where the vaccine was used did the enquiry have any substance. The other farms investigated mostly had transient coughing episodes, which usually were rapidly resolving, frequently before the farm was visited, or outbreaks of other types of pneumonia which were demonstrated when a post-mortem examination allowed diagnosis. On some farms where apparent husk symptons occurred in vaccinated animals and a fever was present streptomycin therapy resulted in a resolution of symptoms and fever within 24—48 hours. This would indicate to us the presence of a bacterial (probably pasteurella) pneumonia. Of the 16 farms mentioned above only 4 had major problems where we had any reason to consider that the vaccine had failed to exert its expected effect. Because other farms vaccinated with material from the same batches were known to have withstood a natural pasture challenge specific factors on these farms are being investigated during the course of this year. On the other 12 farms there were odd individual animals dying with worms in their lungs on each farm, which could be explained either by a biological variation in the capacity of the individual to respond to an antigen or by some animals being missed at the time of vaccination, a procedure frequently being left to the farmer.

In summary then: of these reports the majority, which were due to coughing symptoms in vaccinated animals, resolved with no serious loss of condition or major problem to the farmer. Because of the clinical pictures seen we feel that other pneumonias, in particular so-called cuffing pneumonia, were probably playing a major role here, together with the transitory coughing seen after a vaccinated animal meets a heavy challenge. Of the 16 cases mentioned above, in all those where it was possible to undertake a post-mortem examination of animals, cuffing pneumonia lesions of varying severity were seen. Certainly in 2 of the 4 problem farms pneumonias other than husk were also playing a serious role. On one of these farms a pneumonic disease, diagnosed as cuffing pneumonia by the local veterinary surgeon, was present at the time of vaccination; we believe that this may have adversely influenced the vaccination procedure. On some of the other farms severe cuffing pneumonia was present at the time the vaccinates met a husk challenge. This combination of stresses we believe may have prevented the development of satisfactory anamnestic response. These farms and these particular epidemiological aspects are being investigated during this year.

It is also interesting to note that although 1959 was generally in the British Isles a phenomenally dry year, the incidence of husk appears to have been very high in certain areas of the country. It also appeared

to us that the occurrence of other pneumonias in calves, in particular cuffing pneumonia, was widespread, although we are not sure whether this was an actual increase in incidence or merely an impression due to our particular interests. Clinically, however, husk and cuffing pneumonias appear to be easily confused and may also appear together in the same group of animals. Baxter (1960) in Northern Ireland has also drawn attention to an inclusion body pneumonia of cattle, and described an outbreak which was clinically very similar to parasitic bronchitis.

Although we have at this time very little evidence to substantiate it, we feel that sudden entry into a heavily contaminated pasture may in certain cases be undesirable. When calves which have been vaccinated meet a sudden very high intake of infective larvae as their first field experience of infection it may be that there is not sufficient time to develop the required degree of response. It is felt that some caution should be exercised where high challenge pastures are known to exist and that introduction on to such fields should be gradual. This state of affairs should only exist on certain farms and only during the first year of vaccination.

At the time of preparation of this paper, the 1960 vaccination season (December 1959—June 1960) had just been completed, again with satisfactory results. It is hoped that at the time of presentation of the paper some further information will be available on the results of challenge during this season.

One of the stated disadvantages to the farmer that has been raised in using this method of vaccination is that we have stipulated a procedure to be followed. Calves must be housed from birth until two weeks after the 2nd dose of vaccine. This procedure has been introduced to ensure that all animals undergoing vaccination will be maintained under conditions which will make the acquisition of a natural infection extremely unlikely; it has been thought that this procedure was in some way an integral part of obtaining immunity. It is our feeling that certainly during the early years of use of this method of vaccination every effort must be made to provide the calf with all possible opportunities of developing a successful immunity. We do, however, know of many farmers with beef herds that have vaccinated their animals at pasture without experiencing any problems or difficulties; therefore, provided that animals can be placed on a pasture that is known to be husk-free there is no reason why they should not be vaccinated at, or turned out to, grass before the stated time intervals have elapsed. At the same time we do not depart from our recommended procedure.

Other Respiratory Diseases and Their Relationship to Parasitic Bronchitis

We have already refered above to the existence of other pneumonias in animals involved in vaccination experiences. Taylor (1951) states that an unwarranted reliance is frequently placed upon the "husk cough" for the diagnosis of the disease and that there is no doubt that other lung diseases of cattle are capable of giving rise to the same type of cough. It has become obvious to us during the last two years that this reliance on a typical cough is still in operation by a considerable number of practising veterinary surgeons. We find in our experimental infections with husk that a cough can appear as early as 5 days after infection and usually by the 10th day occurring with increasing severity as the respiratory rate rises.

It would appear that as increasing numbers of animals are vaccinated against parasitic bronchitis it will become more necessary to provide accurate diagnosis when coughing is seen as the main clinical symptom in calves, particularly if these calves have been previously vaccinated. Cuffing pneumonia has already been mentioned; this has been described by Jarrett *et al.* (1953) as a typical bovine pneumonia characterised histologically by a peribronchial hyperplasia of lymphoid tissue. Ottosen (1957) has also described a similar disease in calves in Denmark, he presumed either a virus or rickettsial cause.

Inclusion body pneumonia of cattle has also been recorded in the British Isles (Jarrett, 1954). It has been referred to by Baxter (1960), as presenting a similar clinical picture to husk. Palotay and Christensen (1959) have described a disease that they name "bovine pneumonitis" and have isolated 3 viruses of psittacosis—*lymphogranuloma venereum* group from these cases. They also have succeeded in isolating these viruses from healthy animals and have discussed their possible role in producing disease together with *Pasteurella haemolytica* infection. Clinically the disease appears to resemble husk.

Bacterial pneumonias, in particular associated with *Pasteurella* and *Corynebacterium pyogenes*, can also be seen frequently although here careful examination of the clinical picture presented usually allows a diagnosis to be made. We have also seen a few cases of aspiration pneumonia possibly resulting from the incorrect administration of the vaccine.

The recognition of these other conditions will require more attention to be given to the incidence and significance of these other conditions, with particular reference to diagnostic methods.

Discussion

Before any vaccine is introduced for commercial sale and general field use, apart from the production and the control procedures associated with the vaccine, the manufacturer must be sure that the product he is about to launch for sale is not only going to produce the desired immunological effect but it must also be absolutely safe in use. .

The production of any new vaccine on a mass scale, in particular a vaccine of a completely new type, must necessarily be accompanied by a certain degree of risk that field use may show up some undesirable property that has not been found in field trials. The necessity for including adequate control and safety test procedures to cover all eventualities is something that may not be foreseen at the time that the control procedures are drawn up. However, as experience of the vaccine under production is accumulated a point is reached when it can be said that there is no significant risk associated with the use of the vaccine. Broadly speaking, the expression "safety of the vaccine" refers to the free-

dom of the product from harmful properties as seen when the vaccine has been administered in accordance with the recommended procedure.

During the last three years a considerable number of calves in the British Isles, Denmark, Holland, France, and Belgium, have been vaccinated. At the time of writing this paper it can be said that there is no evidence that the vaccination procedure has either caused husk in the vaccinated animals or in the in-contact animals or acted as a vehicle for transmitting any other disease. We feel therefore that the development and introductory phases of this vaccine are now completed and that it can be used with the knowledge that its safety is well proven.

One of the main techniques applied to the measurement of effects of vaccination against viruses and bacteria is the availability in most cases of easily conducted serological techniques for the measurement of immunity. At present the serological procedures available are extremely limited. We can obtain some indication of the development of antibodies in our vaccinated calves but we are not sure how far this reflects the degree of resistance achieved in the animal. We can however control the potency of the product by knowing exactly the number of larvae in each vial of vaccine.

The other aspect of any new vaccine that is introduced for sale must be its efficacy in producing the desired degree of immunity in the vaccinated subject. It is always difficult to specify exactly what the response in the animal is going to be. We can control exactly the production of the vaccine up to the time it leaves the manufacturer's premises. However, after this time we have got to bear in mind the variations in the handling and the application of the product together with the biological variation that exists in every individual. In fact this consideration of individuality is one that has to be considered carefully in the case of every biological product. The factors associated with the incorrect usage of the vaccine can in the main be overcome by the sensible application of the vaccine in the field. The factors controlling the development of immunity in the vaccinated animal are much more intangible. The status of the antibody-forming structures of the host is dependent on such factors as the age, the general health, and the previous immunological history of the animal.

In reviewing the experiences obtained with husk vaccine we can say with confidence that the vaccine has proved to be, and is proving to be, a valuable means of controlling parasitic bronchitis in the field. All the evidence now indicates that by the sensible application of this vaccination procedure, veterinary surgeons can demonstrate to farmers a method whereby calves can be protected from one of the most serious parasitic diseases in this country.

References

BAXTER, J. T. (1960). *Vet. Rec.* **72.** 437.

DOUVRES, F. W. & LUCKER, J. T. (1958). *J. Parasitol.* **44.** (4 Sect. 2), 28—29.

JARRETT, W. F. H. (1954). *J. Path. Bact.* **67.** 441.

———, JENNINGS, F. W., MACINTYRE, W. I. M., MULLIGAN, W., THOMAS, B. A. C., & URQUHART, G. M. (1959). *Immunology,* **2** 252.

———, MCINTYRE, W. I. M., & URQUART, G. M. (1953). *Rec.* **65.** 153.

———, ———, & ———. (1957a). *J. Path. Bact.* LXXIII, 183.

———, ———, JENNINGS, F. & MULLIGAN, W. (1957b) *Vet. Rec.* **69.** 1329.

JONES, B. V., & NELSON, A. M. R. (1960). *Vet. Rec.* **72.** 395.

OTTOSEN, H. E. (1957) *Nord. VetMed.* **9.** 569.

PALOTAY, J. L. & CHRISTENSEN, N. R. (1959) *J.A.V.M.A.* **134.** 222.

SOLIMAN, K. N. (1953). *J. Comp. Path.* **63.** 75.

TAYLOR, E. L. (1951) *Vet. Rec.* **63.** 859.

THE SPEAKERS' INTRODUCTION

The Chairman, Dr. E. Cotchin, said that the session was to be on an interesting and topical subject. The first paper was to be introduced by Dr. W. F. H. Jarrett.

Dr. Jarrett said that when they discussed husk a few years previously there were neither suitable drugs nor vaccines available to deal with it. They were now more fortunate in these respects but it was still imperative for them to know which clinical stage of the disease was being dealt with in any individual animal.

Husk was best regarded as a disease which could be divided into weekly intervals. The first week was the penetration stage when the larvae migrated from the alimentary tract to the lungs. In the 2 following weeks the larvae grew into adult worms in the trachea and the bronchi and gave rise to the clinical stage of pre-patent husk. In the following 3 weeks the disease was fully developed and the animal showed the typical husk syndrome; larvae were produced in the faeces and at autopsy adult worms could be seen in the lungs. The 2 or 3 following weeks was the post-patent period and larvae were passing through the faeces and only few or no worms could be seen at autopsy. Sometimes an exacerbation of clinical symptoms took place during this time.

Slide: This illustrated larvae of microscopic size in the bronchi and trachea. It was often stated that husk was caused by blockage of the trachea.

In this stage death or severe symptoms often occurred and there was no question of larvae of this size blocking the trachea as they were much too small. Normally clinical symptoms were only seen from about 14 days onwards.

Slide: At this stage there was very little pneumonia due to alveolar consolidation.

Slide: In the pre-patent period some animals went down with fog fever. This was often due to husk. Such larvae might not be seen with the naked eye. One of the contributory factors to clinical distress in this condition was pulmonary oedema. When this was combined with dyspnoea the oedematous fluid in the alveoli evaporated off leaving a thick protein deposit on the alveolar walls. This augmented the clinical condition and led to a vicious circle being set up.

Slide: To turn to the patent stage of the disease, the pneumonia here was caused by the parasite and was not due to secondary bacterial infection.

Slide: A proportion of the eggs laid by the worms were aspirated back into the lungs giving rise to a foreign-body pneumonia. Once this had occurred it was difficult to ameliorate the pneumonia with drugs.

Slide: This illustrated emphysema and was an important complication of the clinical disease.

Slide: In the post-patent stage of the disease calves which showed an exacerbation of clinical signs showed the pulmonary picture of alveolar epithelialisation. The basic cause of this was not known and there was no known remedy.

Slide: It was only recently that there had been an opportunity to study the pathology of reinfection of immune animals and hence to understand the clinical signs associated with challenge.

Larvae which were killed by antibodies or by drugs died in the small bronchi and produced a series of lesions.

Slide: The dead larvae caused proliferation of bronchial epithelium.

Slide: This was followed by the development of lymphoreticular tissue around the bronchi.

Slide: When worms were in the adult stage when killed this reaction now caused an extensive necrosis of bronchi and completely occluded them.

Slide: This illustrated an adult cow which had died in the field because of many of those bronchial lesions caused by a very heavy challenge infection.

Other complications sometimes occurred. In the autumn especially animals suffering from husk sometimes contracted acute interstitial pneumonia and this was worth treating with antibiotics.

The Chairman asked Dr. J. K. Walley to introduce his paper.

Dr. Walley said that he was particularly pleased to be able to address the Congress on husk that morning. It was a subject with which he had been associated for many years. There appeared to be two things missing—and that was said without any disrespect but with the purpose of being objective. First of all, the papers did not really draw attention to the epidemiology of the disease and the difficulties associated with transmission and differential diagnosis. An introductory paper at the beginning of the symposium would have been helpful. Then, at the end of the symposium they might have dealt with the future, and Dr. E. L. Taylor's article which appeared in THE VETERINARY RECORD two weeks before, and which referred to 12 factors they did not know of in the use of immunological methods, would have been excellent. Dr. Michel's and Dr. Taylor's work at Weybridge made a very fine and complete work on husk.*

If ever there was a case where a man might be forgiven for mistaken diagnosis it was in the case of husk. There were still gaps in their general knowledge on the subject. Many found it difficult even now to decide from outside the animal exactly which stage was going on inside. Dr. Jarrett had illustrated what took place due to dead worms. One of the prime features of such things as cyanacethydrazide was that they to some extent activated the worm so that it was removed alive, and if it was not removed it continued alive behind the obstruction, and the animal did not suddenly have inside it a large number of dead worms.

The Swanson school in the United States worked with cyanacethydrazide and they decided as a result of trials that in a word, it was useful. They used 50,000 *Dictyocaulus* to infect cattle and 2 of the 4 animals infected died. One which lived had only 23 adult worms in it. A moderate infection was achieved with 30,000 to 33,000 larvae. Work in Great Britain showed that 5,000 larvae were quite adequate.

Treatment with cyanacethydrazide daily for 3 months, or monthly for 3 years, had no adverse effect on growth, was virtually non-toxic and had no ill effect on live-weight gain.

Another difficulty of treatment of the disease was that in one herd there were virtually all phases of the disease. In all cases it should be treated as a herd problem. The adult worm was the thing first to be rid of and it was likely to be present by the time the practitioner was called in. Although increased respiration was the main clinical symptom, the farmer usually waited for a cough. Some supportive treatment was necessary and it was advisable to use the drug which would remove the bulk of the adult worms—and at present that was best done with cyanacethydrazide.

The paper outlined some fairly extensive trials conducted by Mr. Harrow to assess the value of cyanacethydrazide in prevention. Any drug which acted on the adult worm or the immature worm, as cyanacethydrazide did, had a value in prevention which was going to be limited by that fact, and damage to the lungs was going to be done before the benefits of the so-called prevention were obtained.

Therapy in any disease of farm animals was only an adjunct to good husbandry and good advice. Prevention was better than cure, but on many English farms prevention was virtually impossible by husbandry and it was likely that, in spite of the best immunological supportive treatment that could be advised, there would always be a use of therapy; and there would always be farmers who thought they had got rid of the disease and that the time had come to stop preventive treatment. Therefore, it was clear that for some time there would be use of specific therapy for lungworm disease—something that would remove the adult worms as they appeared in the animals—and the best thing for that was cyanacethydrazide, irrespective of the name by which it was described.

The Chairman asked Mr. W. H. Parker to introduce the next paper.

Mr. Parker said that he was certainly pleased to be taking part in the session on husk. Dr. Walley had had quite a lot to say about diethylcarbamazine in his paper in addition to dealing with the drug on which his work had been focused. Dr. Walley had picked out the points which belittled its usefulness and maintained that it therefore followed that the drug of choice should be cyanacethydrazide. Perhaps it should be left to the members to decide.

Each of the papers before them stressed the question of diagnosis. Some years ago husk was looked upon as something which almost anyone could diagnose with ease, but in the last 7 or 8 years Mr. Parker had learned how difficult it was to diagnose with certainty. Diagnosis had become increasingly difficult with the frequency of a condition which was known as virus pneumonia of calves. In the past 2 summers virus pneumonia had been occurring in circumstances in which husk might occur.

In assessing the value of drugs for combating the disease of husk the criteria which he and Mr. Vallely used were effect on respiration, larvae count, lungworm count after death, general clinical improvement, weight gain and effect on death rates. It was in relation to the last of those that the effects had been most spectacular. After giving calves doses of larvae which would kill 100 per cent. of the controls, if he was able to treat the remainder early in the disease he could not only save their lives but enable them to progress satisfactorily. They might continue to carry a certain amount of the pathological state of the illness, but to an extent which would not be a disadvantage to an animal that did not have to work for its living.

Slide: Respiration was considered the most important sign of lung infestation. No effect occurred until about the second week when respiration rates went up with great speed.

Slide: After treatment with standard doses of the drug the normal weight gain was restored and respiration rates returned rapidly towards normal.

In diseases such as husk field experiments were extremely important because the manner of take-in of the infective agent was so totally different in the field as compared with the experiment.

Michel's work had two points of special importance to them in dealing with diethylcarbamazine and its effect on husk. Michel had discovered that immunity was built up remarkably rapidly—almost over a few days—in the field as the larvae were picked up from the pasture; and, secondly, that there was a retarded development of larvae in the lungs. In the field one could not obtain a time relationship which enabled a proper comparison with the artificial experiment, and in view of immunity and retarded development the picture in the field was entirely different. Diethylcarbamazine worked excellently without the need to determine how long a particular group of calves had been infected.

There had been some criticism about the volume and frequency of the doses. In an experiment carried out earlier this year a single dose of 20 mg. per lb. had proved almost as effective as the standard 3 doses of 10 mg. when judged by the usual criteria.

There was little hesitation in suggesting the drug was adequate for practical purposes. Diethylcarbamazine would knock the worms for six out of calves' lungs, but it would not touch virus pneumonia.

---

* "The Place of Vaccines in the Control of Parasitic Bronchitis in Cattle" (*Vet. Rec.* **72**: 684).

XUM

The Chairman asked Dr. D. Poynter to introduce his paper.

Dr. Poynter said he was pleased to receive an invitation to take part in the meeting and he wished, through the medium of slides, to give some idea of the mechanism which it was thought operated with regard to immunity against husk. In order to work on a laboratory scale *Dictyocaulus viviparus* was put into guinea-pigs and it was found that the worm went relatively well in that animal.

Slide: A guinea-pig was given 5,000 *Dictyocaulus viviparus* larvae. After 24 hours they were able to obtain a picture of what happened when the larvae had penetrated through to the lung and broken through the capillaries to enter the alveoli. It was necessary to keep the larvae about 6 days to get lung lesions and appreciable recoveries of worms from the lung. The age of the infective larvae was a definite factor.

Slide: Infective larvae were exposed to varying amounts of irradiation and given to guinea-pigs. The guinea-pigs were killed at 10 days and worms were recovered from their lungs. There was an increase in the number of larvae found in the lung when irradiation was used at a level of 2,000 roentgens. When 40,000 roentgens were used there were no worms present in the lungs after 10 days; and that was the dose of irradiation used to make the vaccine.

Slide: By the serial slaughter of guinea-pigs given larvae irradiated at 40,000 r. it was found that they were affected at the late fourth stage, during the transition beween the fourth and fifth stages, or even in the early fifth stage.

The vaccine allowed the worm to undergo a lot of development including the stages concerned in the stimulation of immunity in the animal. All these stages occurred in the lung.

Slide: The majority of guinea-pigs required two larval exposures to render them completely resistant, and it made no difference whether they were made resistant with normal or irradiated larvae. Larvae rapidly reached the lungs of susceptible and resistant guinea-pigs. In the resistant animal the subsequent inhibition of the parasite takes place in the lung.

Slide: It was apparent that irradiated larvae reached the lungs of susceptible calves. Normal larvae also reached the lungs of resistant calves and the lung seemed to be the main site of larval suppression.

The General Discussion

The Chairman said they had had an extremely interesting introduction to a subject which was obviously complex. There seemed to be something for everybody to consider and discuss—the clinician, the pathologist, the immunologist and others. A whole host of subjects impinged on the problem of husk.

Mr. J. B. White (Salisbury) asked whether animals suffering a simultaneous infestation with stomach worms required a lower level of larval infection to produce clinical husk.

Dr. Walley replied that if an animal was low in condition due to any cause—and the presence of stomach worms was as good as any—then it would need fewer larvae to be ingested in order to create clinical stages of the disease. With fewer worms, however, there would be a condition which was easier to resolve by subsequent treatment through therapy and/or management.

Dr. W. I. M. McIntyre said that he did not know of any actual test which would provide a definite answer for Mr. White.

Dr. Poynter said that some experiments concerned with the question had been carried out recently and the stage had been reached where work was being done with two infections of parasites in one animal, one being *Dictyocaulus viviparus* in the lung and the other *Trichostrongylus colubriformis* in the gut. There seemed to be no interference between the two species and further work was in progress.

Mr. J. B. White said that he had seen in the last 2 or 3 years husk in adult beef cows which were grazing or feeding on ground simultaneously with their calves right from birth. They grazed one pasture, went off it for a month or 6 weeks, and then returned. The cows succumbed to husk—some of them showed fog fever symptoms, some of them just husk—and a number of them died. The calves showed no sign of husk at all. There appeared to be a threshold of infestation beyond which the cows could not go. Also, could anything more be said about the apparently wonderful protective value of milk?

Dr. Jarrett said they must be honest and say they did not know all of the answers in the difficult matter of adult infections. It would seem unwise to comment on individual cases without having seen them. There was, of course, the factor of heavy infection in an animal whose immunity was waning; and the amount of herbage eaten must play an important part. Experiments had been carried out on calves on markedly different planes of nutrition, and the worms got through in equal numbers in both categories.

Mr. T. F. Vallely said that Mr. Michel had exposed a group of calves to a level of infestation which was not sufficient to give clinical husk, and then put half of them on clean pasture and half on the pasture originally used. The animals that died were the ones put on the clean pasture. Removal of animals from the pasture originally used caused a break in the immunity.

It was surprising that the calves referred to by Mr. White did not have clinical husk as well. A calf suckling a cow would probably pick up a relatively small infestation because its intake of grass would be comparatively low.

Dr. Walley said he would like to ask a question himself. They read of resting or dormant husk larvae waiting for the opportunity to cause disease. Had anyone ascertained the position of the larvae and what they were doing while they were waiting?

Dr. Jarrett said that he had not been able to find out where hypothetical dormant worms were located and it would be a difficult thing to do technically. The answer to the question was really unknown. To find such answers would be very expensive and would involve more than the odd calf here and there. A lot of money would be needed to find an answer.

Mr. R. L. Cornwell (Liverpool) said that the reinfection phenomenon was an important aspect of the disease. They had learnt that irradiated and non-irradiated larvae reached the lungs with equal facility in both the susceptible and the resistant calf. What happened to the larvae in the lungs of the vaccinated calf? It appeared that they were retarded at about the fourth larval stage and then destroyed, the dead larvae stimulating a marked lung reaction. Were all the larvae reaching the lungs killed or were some eliminated *via* the trachea?

In Mr. Cornwell's own experience there was great danger in subjecting the vaccinated calf to a sudden heavy challenge. Under these circumstances reinfection severe enough to kill the animal might occur. This might be linked with the marked reaction to dead larvae in the immune calf.

Poynter *et al.* in their paper reported that irradiated larvae in the guinea-pig did not develop beyond 6 or 7 days in the lung. In the calf, however, a dose of 1,000 irradiated larvae produced small numbers of adult worms in 4 out of 12 calves killed at 30 days and 3 out of 62 calves killed at 8 weeks. Would Dr. Poynter say whether or not these worms were producing larvae?

Dr. Walley in his paper also mentioned removing small numbers of worms from the lungs of 5 calves following vaccination. Was the infection patent in these animals? Had they been withheld from reinfection after vaccination?

Dr. Poynter said that on the question of adult worms arising from X-irradiated larvae, the figure of 3 out of 62 referred to calves which received standard batches of vaccine. In 3 of the calves worms were found in the lungs. The numbers were comparatively low. The worms were adult. They had eggs and the eggs had motile larvae inside them. The vast majority of worms were killed but there were some that got through and reproduced. That might or might not be a desirable thing.

Mr. Bruce V. Jones (Clavering, near Saffron Walden), said that one of the major undertakings when the commercial handling of the vaccine was taken over, and before it was introduced for sale, was to confirm and make sure that it was completely harmless. It was necessary to ensure that it could not produce husk or transmit any other disease to calves that were vaccinated. A considerable volume of clinical evidence from both this country and overseas had now been collected and there was no reason

to change the view that the vaccine was completely safe in field use.

As regards sudden heavy challenge in vaccinated calves, although there was not a lot of evidence to substantiate the opinion, it was felt that calves should not be suddenly turned on to pastures where there had been a serious husk problem in the past. It would probably be wiser for the animals to be put on to the pasture in a gradual way. This situation should only apply on certain farms and only during the first year of vaccination.

Mr. J. M. Ingram (Oxted) asked whether there was any means of finding out the number of doses of Franocide or other preparation which had been issued in the attack on the disease.

Dr. Walley said he had heard that in the seasons concerned there were hundreds of thousands treated with Dictycide.

Mr. J. W. Barber-Lomax (Chorley Wood) said that during 1959 and the present year to date his organisation had distributed at home and overseas something in excess of material sufficient to dose just over a quarter of a million animals with the recommended 3 successive doses.

Dr. McIntyre said that, before the question of excessive challenge passed from their minds, he would point out that in a final experimental trial an animal stood up to a single challenge dose of 10,000 larvae without producing any worms at *post-mortem* examination. That number represented a highly lethal dose.

Mr. R. Kenworthy (Woking) asked whether Dr. Jarrett had any comments to make about adenoma. Had he seen it in adult animals and what was the extent of the lung involvement? Had he seen anything that could be described as an adenomatosis lesion, particularly associated with the lymph nodes?

Dr. Jarrett said that this condition was the same as the epithelialisation he had described under the heading of post-patent husk. The lesions started during the patent stage and usually subsided but sometimes for an unknown reason it flared up and was a frequent cause of fog fever.

Mr. R. L. Cornwell (Liverpool) said that the previous year he had challenged 2 vaccinated calves with 10,000 larvae. The challenging infection became patent, the respiratory rate doubled and the calves showed moderate symptoms of husk. They lost a little weight but after a few weeks returned to normal. The experiment was repeated this year on 4 calves vaccinated in the normal way and challenged with 5,000 to 10,000 larvae according to size. The same results were obtained, the larval excretion rising to 70 per gramme in one calf.

Experience with the vaccine in the field was on similar lines. If vaccinated animals were put onto moderately infected pasture, mild symptoms were produced. Most of the animals passed larvae in the faeces, coughed a little and recovered without any untoward signs. One calf exposed suddenly to a very heavy field challenge, which had been responsible for the death of 2 susceptible calves, succumbed in the pre-patent stage with thousands of immature worms in the lungs. That was not surprising; the vaccine could not be expected to stand up to that sort of test.

Dr. Jarrett said he felt it was important when talking about such matters to define one's terms and to say exactly what had been done and to give figures. The vaccine used by him and his colleagues was made by them in the laboratory and the calves were carefully reared and parasite free. The experiment, therefore, was tightly controlled and it was important that details of it should not be misquoted out of context.

Dr. Poynter said that a breakdown must be regarded as a thing that could happen. The reasons for it were at present still obscure. Many calves used for larval production had now gone through their premises and there was quite obviously an individual variation amongst the animals and their reaction to the parasite. It was really to be expected that a few animals would not respond as well as others to the vaccine.

Mr. Bruce V. Jones said that at the end of the day one could only judge a vaccine by what happened in the field. He and his colleagues had checked the Glasgow work and found it quite valid and reasonable. Confirmatory checks had recently been carried out in the U.S.A. and on the Continent with completely satisfactory results.

The vaccine was doing an extremely valuable job not only in this country but overseas as well and in many places where husk had been a serious problem calves could now be kept and reared at pasture.

Dr. McIntyre said he would like to hear some reassurance from practitioner colleagues.

Dr. G. M. Urquhart said that in Mr. Cornwell's experiments, the challenge was so severe that 4 out of 5 unvaccinated calves died of husk, the faecal larval counts exceeding 2,000 per gm. None of the vaccinates died, they showed only mild symptoms of husk and the faecal larval counts did not exceed 8 per gm. The level of protection afforded by the vaccine was therefore very high and any criticism of the vaccine should be viewed in this perspective.

Mr. Cornwell said that his remarks had not been made in criticism. The vaccine was working excellently in the field. His intention was to point out that his results did not accord with those of the Glasgow workers, which might lead one to believe the vaccine was 100 per cent. efficient. The vaccine did a very good job; it was not 100 per cent. effective.

Dr. W. Mulligan said that Mr. Cornwell had apparently started experimenting with 2 calves and had gone on to use 4 and then had dealt with the behaviour of 1 calf. It seemed to him that a great many people in parasitology carried out too many experiments of this type which were much too small for definite conclusions and he thought that the statistical considerations which normally governed scientific work should also be applied to parasitology and that people should not draw conclusions from the type of experiment carried out by Mr. Cornwell.

Mr. A. M. McFerran (Scarborough) said that after Dr. McIntyre had spoken to the farmers in his area, one of them decided to do a controlled experiment. Out of 40 calves, 20 were dosed with Dictol. After some months the 20 that were dosed were actually up to 1 cwt. heavier than the other 20, and the 20 that were not dosed were not showing any signs of husk. There was no coughing and they were all in good heart and condition.

Mr. J. R. Brunsdon (Glastonbury) said he was modestly happy about the husk situation in that it could be treated and the mortality rate was small. But he was not happy about the fog fever syndrome. The dry form was seen in a large number of animals and it could now be coped with. Wet fog pneumonia would seem to be a different kettle of fish. It picked out individual animals in a herd. Was one on a losing wicket when dealing with it?

Dr. Jarrett said that one was diffident about answering questions without seeing the cases. One did not want to be interpreted as saying that fog fever was always husk. The condition described as "wet" seemed to be the stage of disease in which heart failure had supervened.

Dr. McIntyre said that the occurrence of the so-called "wet" and "dry" types of fog fever might be a matter of timing. The animals which died from heart failure over a course of a few hours were more likely to have oedematous lungs. The amount of fluid present in the final few hours of life varied enormously from case to case.

He wished to take this opportunity to describe an experiment on Franocide. 18 calves were divided into 3 groups and all were given 4,000 larvae. One group was treated on days 14, 15 and 16 and another group was treated on days 31, 32 and 33. All 3 groups were slaughtered on day 37. In the early treated group the result was spectacular and the infection was completely blocked. In the late treated group, *i.e.*, the group treated when in the fully developed clinical stage, there was no difference from the controls and the drug did not seem to have any beneficial action. There were no significant differences in respiratory rate, larval output or worm counts.

In Dr. McIntyre's opinion too much had been made of the difference between the experimental disease and the natural disease. In endemic husk areas the normal clinical case was exactly the same as that produced experimentally.

Mr. A. M. R. Nelson (Ware) asked Mr. Parker if he

(*Concluded at foot of page* 1090)

The Effect of Water Intake on the Response of Growing Pigs to an Antibiotic Supplement in the Diet

BY

J. O. L. KING

School of Veterinary Science, University of Liverpool

SUMMARY.—Seventy-six Large White pigs, divided into 19 groups with 4 pigs in each, were housed in pens fitted with individual feeding stalls in a Danish-type piggery. One pig in each group was fed on a basal diet plus 3 lb. of water per lb. of meal, a second the same ration plus 2½ lb. of water per lb. of meal, a third received the same diet supplemented with 20 mg. of oxytetracycline hydrochloride per lb. plus 3 lb. of water, and the fourth this antibiotic supplemented diet plus 2½ lb. of water. Figures for the average increase in weight per week and the average food consumption per lb. live-weight increase are given for the pigs divided into two age ranges of 6 weeks' duration each from 9 to 15 weeks and 15 to 21 weeks of age.

There were no significant differences between the average weekly weight gains of the pigs on the basal diet plus the two levels of added water, nor on the antibiotic supplemented and basal diets plus 3 lb. of water in either age range. By contrast when the average weekly weight increases of the pigs on the antibiotic supplemented and basal diets plus 2½ lb. of water in the earlier age range were compared, the pigs receiving the antibiotic grew significantly more rapidly than the controls and consumed significantly less food per lb. live-weight increase. In the older age range the comparable differences were not significant. When the weight increases of the pigs on the antibiotic supplemented diet at the 2 levels of water were compared it was found that, while in the earlier age range, the pigs receiving 2½ lb. of water per lb. of meal increased in weight significantly more rapidly than those consuming 3 lb. of water per lb. of meal. The difference in the weight gains of the pigs in the older age range was not significant and there was no significant difference in the average food consumption of the pigs in either age range.

Introduction

MANY pigs being fattened for bacon are fed on a sloppy mixture of meal and water and are not provided with any other source of water. Thus they cannot regulate the relative proportions of meal and water which they consume. The quantity of food eaten will be restricted if the proportion of water is markedly too low or too high. The first response of a pig to a restricted water intake is a reduction of food consumption, and if the meal/water mixture is made too thin the ration becomes so bulky that the pigs have to limit the amounts of food they consume according to the capacities of their digestive systems.

In spite of the obvious importance of the meal/water ratio there is not much scientific evidence on the actual amounts of water required by pigs of

---

Symposium on Husk.—*Concluded.*

could enlighten them on the pharmacological action of diethylcarbamazine. In the man there have been reports of certain side effects, including reduction of peripheral eosinophilia, and it has been reported by several veterinary surgeons he had met that there was evidence of a non-specific effect where cases, which subsequently were proved to be some condition other than husk, responded to treatment with diethylcarbamazine. An example was given of one case where one animal in a group of a dozen showed symptoms suggestive of acute husk but none of the remainder showed any symptoms either at the time, or later. The affected animal responded to treatment with diethylcarbamazine.

Mr. Parker said that he had no comment to make on the point, but he would like to refer back to Dr. McIntyre's remarks. To claim that there was no difference between the artificial and the field condition of husk was quite untenable. Diethylcarbamazine given in an experiment was properly effective only if applied early. At Frant experiments were carried out over a period of days and the maximum effect was found to be at the 13th to 15th days. In his own field experiments remarkable effects were achieved with the drug when larvae were already appearing in the faeces. In one field experiment animals were treated a month after they had been unsuccessfully treated with another drug. The calves were infected with virus pneumonia, which was probably a debilitating factor, but the effect on the larvae even at that stage was spectacular.

Dr. Walley said that Mr. Nelson had raised an important point concerning the apparent odd effects of treating with any of these anthelmintics animals which appeared not to be parasitised in terms of faeces. It was very difficult in lungworm infestation to ascertain a true relationship between the bacterial picture and the cause of the disease. The problem appeared to be that there was one drug which acted best on immature worms and one that acted best on the mature. The obvious thing was to marry them in theory and ascertain an adequate dose.

Mr. Vallely said that development of immunity was what made him think there was no true comparison between the experimental infestation and natural outbreaks as encountered by practitioners. Dr. Jarrett maintained that in the part of the country where they were meeting about 90 per cent. of the outbreaks were strictly comparable with experimental infestation. In a lot of outbreaks there was clinical husk in partially immune animals, and it was therefore felt that a lot of the worms were held at the pre-adult stage. The infestation might be 40 days old but the worms were in fact 15 to 20 days old.

The Chairman said he was sure that the meeting would wish to thank all who had taken part in the discussion, particularly the authors, for making it an extremely interesting and successful symposium. (Applause.)

different weights. Complicating factors are that the quantities consumed undoubtedly vary according to the ingredients of the ration and the environmental conditions. Linton and Williamson (1943) put forward the general rule that the supply of water should be 3 lb. for each 1 lb. of meal up to 100 lb. liveweight, and that thereafter the demand will gradually fall to half that amount at 200 lb. bodyweight. Davidson (1948) gives figures per lb. of dry matter in the ration of 2.62 lb. for pigs weighing 25 lb., 2.35 lb. for pigs weighing 50 lb., 2.40 lb. for pigs weighing 75 lb., and 2.04 lb. for pigs weighing 100 lb. with a gradual reduction to 1.35 lb. for pigs weighing 200 lb.

Numerous feeding trials have shown that in most instances the addition of a small amount of an antibiotic to the ration will improve the growth rate of apparently healthy pigs by from 10 to 20 per cent. and increase the efficiency of food utilisation by up to 10 per cent. Cases are, however, encountered in which there is only a slight improvement in growth rate, or no response at all, and a number of factors are known to influence the results obtained from antibiotic feeding. The effects are most marked in young pigs and decrease with advancing age. In general the best results are obtained on farms which are hygienically poor and antibiotics improve the response to poor quality rations to a greater extent than to good well-balanced diets. Further study is, however, needed to find other factors which can influence the response of animals to antibiotic feeding.

Braude and Johnson (1953) found that pigs receiving chlortetracycline in their diet consumed a little more food and drank a little more water, but the food/water intake ratio was the same for the two groups, indicating that if there was any trend for a higher water intake in the pigs receiving the antibiotic, it was due to higher food consumption rather than to any effect of the antibiotic. However, the addition of an antibiotic to the diet caused a considerably higher (statistically highly significant) urine output. The difference could not be accounted for by the small increase in the water intake. Robinson *et al.* (1953) found that penicillin did not stimulate the growth of pair-fed pigs whose water consumption was controlled while a growth response was obtained in similar animals offered water *ad lib.* They observed that the excretion of water through urine and faeces was higher in penicillin-fed pigs than in the controls when water intake was equated, and that the water intake was considerably lower in the treated than in the control pigs when water was offered free choice. These results constitute evidence of greater water economy in pigs fed an antibiotic.

Slinger and Pepper (1955) studied the effect of water intake on the growth response of groups of turkey poults and fowl chicks to penicillin. In both species the addition of penicillin to the diet resulted in about the same growth response in the groups whose water intake was restricted as in those receiving water *ad lib.* The interaction between penicillin and the method of watering was not statistically significant. In general poults and chicks fed penicillin exhibited less desire for water than the controls, and the results indicated that penicillin tends to have a "sparing" effect on the water requirement of these species.

In an attempt to find if the amount of water consumed affected response to antibiotic feeding the present experiments were designed to study the significance of controlled levels of water intake on the growth rate of growing pigs fed oxytetracycline. Both the water levels used were within the limits generally regarded as normal.

Experimental Method

Housing

The pigs were housed in fours in pens in a well-insulated Danish-type piggery. Each pen was provided with a dunging passage from which foul air was extracted by an electric fan, and 4 feeding stalls to which the pigs were admitted twice a day for feeding.

Feeding

The basal diet throughout consisted of weatings 45, barley meal 30, flaked maize 14½, fish meal 7½, grass meal 2½, vitamin supplement (A and D) ½, all parts by weight. To 2 pigs in each group it was fed unsupplemented, and to the other 2 with the addition of 20 mg. of oxytetracycline hydrochloride* per lb. of diet. The pigs were fed to appetite, the weight of the meal fed to each pig being altered once or twice a week as required, up to a maximum of 5½ lb. per day. The individual feeding pens enabled the food consumed by each animal to be calculated accurately. The pigs were fed twice daily at 8.30 a.m. and 4 p.m. The meal was mixed with water allowing 3 lb. of water to each lb. of meal for one pig on the basal and one pig on the supplemented ration and 2½ lb. of water to each lb. of meal for the other 2 pigs. These food:water ratios were continued throughout the period of feeding. There was no other source of water.

Pigs

Seventy-six pigs were used, divided into 19 groups with 4 pigs in each. Thirty of the pigs were hogs and 46 were gilts, the sexes being distributed as evenly as possible through the different diet treatments. The pigs selected were as even in size as possible, and the 4 pigs in each group came from the same litter.

They were all Large Whites and were either home-bred or purchased at 8 weeks of age. They were placed in the experimental pens when 8 weeks old, and were allowed 1 week in which to become accustomed to their new surroundings and the feeding pens before records were made. The pigs were weighed once a week. One pig fed on the basal diet plus 2½ lb. of water had to be destroyed during the 20th week of life.

* Added in the form of Pfizer Ltd., Terramycin (Animal Formula soluble powder).

Results

TABLE I
THE AVERAGE LIVE-WEIGHT GAINS OF, AND AMOUNTS OF FOOD CONSUMED PER LB. LIVE-WEIGHT INCREASE BY, THE PIGS IN TWO AGE RANGES OF 6 WEEKS DURATION EACH

Diet	Average increase in weight per week (lb.)		Average food consumption per lb. L.W.I. (lb.)	
	9 to 15 weeks of age	15 to 21 weeks of age	9 to 15 weeks of age	15 to 21 weeks of age
Antibiotic + 3 lb. water per lb.	6·9	9·8	2·9	3·4
Basal + 3 lb. water per lb.	7·0	9·7	2·9	3·4
Antibiotic + 2½ lb. water per lb.	7·7	10·0	2·7	3·3
Basal + 2½ lb. water per lb.	6·7	9·8*	3·0	3·4*

*These figures only relate to 18 pigs. All the other figures are the averages of the results obtained from 19 pigs.

(1) *Basal diet plus 2½ and 3 lb. of water per lb. of food*

On the basal diets the pigs which only received 2½ lb. of water with their food increased in weight less rapidly than those being given 3 lb. of water in the earlier age range and slightly more rapidly in the later age range, but the differences were not significant. The food consumption figures showed that the pigs on the 3 lb. of added water diet were slightly, but not significantly, more economical in the early age group, and that there was no difference in the later range.

(2) *Antibiotic supplemented and basal diets plus 3 lb. of water per lb. of food*

During the age range from 9 to 15 weeks the pigs on the basal diet increased in weight slightly more rapidly than those on the supplemented ration, and in the next 6 weeks those on the diet with antibiotic grew slightly faster. Neither of the differences were significant. The food consumption figures were the same for the pigs on both diets in the two age ranges.

(3) *Antibiotic supplemented and basal diets plus 2½ lb. of water per lb. of food*

Between the 9th and 15th weeks of age the pigs on the diet containing antibiotic increased in weight at an average rate of 7.7 lb. per week as compared with only 6.7 lb. per week for those on the basal diet. The difference between these weekly increases was significant at the 1 per cent. level. In this age range the average food consumption per lb. live-weight increase was 2.7 lb. for the antibiotic fortified food group and 3.0 lb. for the control group, the difference between these amounts being significant at the 5 per cent. level. In the older age range the pigs receiving antibiotic increased at an average rate of 10 lb. per week and consumed 3.3 lb. of meal per lb. live-weight increase as against 9.8 lb. and 3.4 lb. respectively for those on the basal diet, neither of the differences being significant.

(4) *Antibiotic supplemented diet plus 2½ and 3 lb. of water per lb. of food*

The pigs which only received 2½ lb. of water per lb. of meal put on an average of 7.7 lb. per week as compared with 6.9 lb. for those being given 3 lb. of water per lb. of meal. The difference between these averages was significant at the 1 per cent. level. The average food consumption per lb. live-weight increase of the pigs on the lower intake was 3.7 lb. while the figure for those receiving the higher water level was 2.9, but the difference was not significant. In the older age range the pigs being given 2½ lb. of water per lb. of food averaged an increase of 10 lb. per week while those consuming the food plus 3 lb. of water only averaged 9.8 lb. Per lb. live-weight increase the food consumption figures were 3.3 lb. for those on the 2½ lb. of water per lb. of food, and 3.4 lb. for those on the 3 lb. of water. These differences were not significant.

Discussion

There were no significant differences in the weight increases of the pigs on the basal diet plus the two levels of water in either age range, and so it would appear that the difference in the water intake did not, of itself, affect growth rate. It might be considered that the volume of water fed to the pigs when in the older age range should have been reduced at both levels, but for the sake of uniformity they were maintained at the same amounts throughout.

There were no significant differences between the average weekly weight increases of the pigs on the antibiotic supplemented and basal diets plus 3 lb. of water in either age range, and so in this experiment at this level of added water the antibiotic does not seem to have had any effect. By contrast, when the average weekly weight increases of the pigs on the antibiotic supplemented and basal diets plus 2½ lb. of water in the young age range are compared, the pigs receiving the antibiotic grew more rapidly than the controls (differences significant at the 1 per cent. level of significance), and consumed less food per lb. live-weight increase (difference significant at the 5 per cent. level of significance). In the older age range the differences in the comparable results were not significant.

When the weight increases of the pigs on the antibiotic supplemented diet plus the two levels of water were compared it was found that, while in the earlier range, the pigs receiving the lower level of added water increased in weight significantly more rapidly than those consuming the larger volume of water. There was no significant difference in the average food consumption of the pigs while in this age range, and neither differences in weekly weight gain nor in efficiency of food utilisation were significant when the pigs were older.

The pigs were kept until they reached about 200 lb. live-weight and were then marketed for bacon, but grading results and carcase length measurements obtained from a commercial bacon factory did not indicate that there were any significant differences between the carcases in any of the groups.

(*Concluded at foot of col. 1, page 1093*)

Current Literature

ABSTRACTS

The Distribution of Avian Encephalomyelitis in North America as Indicated by an Immunity Test. TAYLOR, J. R. E., & SCHELLING, E. P. (1960). *Avian Dis.* **4.** 122.

Eggs were obtained from some 2,000 breeding flocks in the U.S.A. and Canada and examined to see if they would support the growth of the virus of avian encephalomyelitis (I.A.E. or "epidemic tremor"). Failure to support such growth was taken as evidence of immunity following natural infection earlier in life. Fifty-seven per cent. of 5-month-old flocks showed immunity, and 96 per cent. of 13- to 18-month-old flocks.

The authors suggest that the test should be used to select resistant breeding flocks so as to avoid the occurrence of clinical infection in their chicks.

E. A. G.

A Survey of *Demodex canis* in the Skin of Clinically Normal Dogs. KOUTZ, F. R., GROVES, H. F., & GEE, C. M. (1960). *Vet. Med.* **55.** 53.

The authors examined 204 normal dogs with no skin lesions.

Sections of skin from 108 (52.9 per cent.) of these contained *Demodex canis*. The ages ranged from 3 months to 12 years with 28 being under 1 year, 139 between 1 and 3 years, and 37 over 3 years. Demodectic mites were found in 57 per cent. of those under one year, in 51 per cent. of those aged 1 to 3 years, and in 57 per cent. of those over 3 years. There were 115 males and 89 females. Mites were found in the skin of 52 per cent. of the males and in 54 per cent. of the females. Ninety were long-haired and 114 were short-haired. Mites were found in 57 per cent. of the long-haired breeds, and in 50 per cent. of the short-haired. In 6 areas examined, the upper lip was positive the greatest number of times with 32.8 per cent.; the right eye 27.9 per cent.; the left eye 25 per cent.; the lower lip 16.6 per cent.; the left cheek 14.7 per cent.; and the right cheek 13.2 per cent.

The authors conclude that other factors must be causative of skin lesions in clinical cases of demodectic mange.

R. C. F.

The Effect of Water Intake on the Response of Growing Pigs to a Antibiotic Supplement in the Diet.—*Concluded.*

Acknowledgments.—The author wishes to thank Professor J. G. Wright for allowing the work to be undertaken, and Miss M. C. Austin for looking after the pigs.

References

BRAUDE, R., & JOHNSON, B. C. (1953). *J. Nutrit.* **49.** 505.
DAVIDSON, H. R. (1948). "The Production and Marketing of Pigs." Longmans, Green & Co., London, p. 164.
LINTON, E. G., & WILLIAMSON, G. (1943). "Animal Nutrition and Veterinary Dietetics." Green & Sons Ltd., Edinburgh, p. 7.
ROBINSON, K. L., COEY, W. E., & BURNETT, G. S. (1953). *Chem. and Ind.* **1.** 18.
SLINGER, S. J., & PEPPER, W. F. (1955). *J. Nutrit.* **57.** 319.

African Horse Sickness. Annotation (1960). *Lancet.* **2 (1960).** 84.

In fully susceptible horses the mortality rate from African Horse Sickness may exceed 90 per cent. Mules are less susceptible and donkeys, though they may be infected, rarely die of the disease. There is no evidence that the virus will infect man. The disease is normally confined to South and East Africa but severe outbreaks have occurred in Egypt and the Middle East. Recent reports from 7 countries in the Near and Middle East indicate the existence of a severe epizootic and there are indications that the disease may spread to India and Asia. There are believed to be 7 immunologically different types of virus and there may be fairly wide strain differences within each serotype. A polyvalent vaccine containing all 7 types has been developed in South Africa and has proved an efficient means of control and prophylaxis.

An outbreak of African Horse Sickness affected the Sudan, Egypt and Palestine in 1944. The virus strains then isolated in Egypt and Palestine were very closely related to each other and also to two strains included in the standard polyvalent South African vaccine. That vaccine completely controlled the outbreak. The present outbreak in the Near and Middle East appears to be caused by a virus antigenically different from the strains previously studied. It may be that the 7 strain polyvalent vaccine will prove ineffective in controlling the disease. Admittedly a vaccine could be prepared against the new Asian strain but this will take time. Meantime other methods of control should not be overlooked. These include strict control of movement of horses, mules, and asses, and the use of insecticides. The control of blood-sucking insects, particularly species of culicoides, can play an important part in limiting the spread of the disease. Thus, in addition to insecticides, smoke screens and other insect repellants have been found useful.

The origin of the present epizootic is not clear. In 1944 it was thought that infection was brought into Egypt by infeced horses, mules, or asses. The possibility exists that infected culicoides may be carried considerable distances by aircraft. These insects are attracted by light and could well enter a fully-lighted aircraft so carrying infection from an enzootic area to a clean area. The annotation mentions that the spraying of passenger planes is on most occasions perfunctory.

The Food and Agriculture Organisation of the United Nations has planned a campaign to cover the whole affected area, and an informal conference of directors of veterinary services of the countries was held in August.

G. F. B.

Hydatid Disease in North Wales. JONATHAN, O. M. (1960). *Brit. med. J.* **1 (1960).** 1,246.

This paper deals with certain epidemiological and surgical aspects of hydatid disease as seen during recent years in North Wales. The relatively high

incidence of hydatid disease in South Wales has been reported by other authors in the past.

During the period January, 1948, to December, 1957, 44 cases of hydatid disease were treated in North Wales hospitals and the data of these cases furnished the material for this paper.

Approximately 4 per cent. of the sheep slaughtered in the Wrexham rural district are infected with liver hydatid disease. The public abattoir staffs are well aware of the significance of these cysts and offal is carefully disposed of at a central depot. In the industrial areas the position is not so satisfactory owing to a multiplicity of small slaughterhouses making strict supervision difficult. In one area with a population of 90,000 there are 13 slaughterhouses. Stray dogs undoubtedly gain access to sub-standard abattoirs, where because of the sheep infestation, the infectivity rate must be high. Other practices such as occasional slaughtering on farms, feeding dogs with dead sheep carcases, and the sale of offal as manure, all contribute to maintaining the incidence of infection in dogs.

A high proportion of the cases in this series occurred in and around the industrial areas of Flintshire and Denbighshire and along the more heavily populated North Wales coast.

The number of stray and unlicensed dogs in the area is said to be large. Twenty-four patients in the series were dog owners. Though the incidence in Wales is low compared with many other sheep-rearing countries, it remains higher than in other parts of the United Kingdom.

The clinical features of the various types of cysts seen in the series are discussed. The two main sites are the liver and the lungs. It is emphasised that particularly in the liver the disease is characterised by latency. Symptoms when they do occur are usually the result of complications occurring in the cyst. Details of the diagnostic criteria are described. Calcification of cysts in the liver and spleen was demonstrated radiologically in a high proportion of cases.

Surgical treatment was directed to achieving a complete removal of the parasitic membrane. It varied in technique according to the site of the cyst and the complications present. Out of the 44 cases, 34 patients were treated surgically and there were 4 deaths. Three patients died from complications of the cyst and 1 from post-operative haemorrhage. All 4 patients were 60 years of age or over. There were no deaths at any age in patients with uncomplicated cysts.

Drug-resistant Staphylococci in the Farmyard. Annotation (1960). *Lancet.* **1 (1960).** 1,338.

Seven years ago regulations were made permitting the addition of penicillin and chlortetracycline to the diet of pigs and poultry. The accelerated growth-rate of animals fed on diets containing antibiotics is well known and the economic advantages have led to the widespread addition of antibiotics—particularly tetracycline. The wisdom of this procedure in view of the possible development of drug-resistant infections in animals has been questioned.

Though changes in the bacterial flora of the intestinal tract have included a reduction in the numbers of certain species notably *Clostridium welchii*, the emergence of drug-resistant strains of *Escherichia coli* (Smith & Crabb, 1957), *Cl. welchii* (Smith, 1959), and probably other intestinal bacteria has been shown to occur. Smith and Crabb (1960) have shown that pigs and chickens fed on antibiotics and also their attendants may become carriers of drug-resistant staphylococci. Studies of 160 pigs in 16 herds, and 38 pigs in 4 herds showed the emergence of a high proportion of antibiotic-resistant strains of *Staph. aureus*. Comparable observations were made on flocks of poultry. The staphylococcal carriage of the attendants in these flocks was then studied. Of 37 men looking after pigs not fed antibiotics, 35 per cent. carried *Staph. aureus*; 5 per cent. carried penicillin-resistant strains, but none carried tetracycline-resistant strains. Of 35 men looking after tetracycline-fed pigs, 57 per cent. carried *Staph. aureus*; 11 per cent. carried penicillin-resistant strains; 34 per cent. carried tetracycline-resistant strains; and 3 per cent. carried strains resistant to both antibiotics. In a group of 50 attendants of tetracycline- and penicillin-fed chickens the rates were: total *Staph. aureus* 48 per cent. penicillin-resistant 30 per cent., tetracycline-resistant 14 per cent., resistant to both antibiotics 4 per cent.

Thus, as in hospitals, both cross-infection and antibiotic administration appear to have played a part in the increased prevalence of drug resistance. At least in the attendants the presence of antibiotic in the environment seems likely to have been a factor.

The possibility exists that the dry meal fed to pigs would more readily yield antibiotic-laden dust than the pelleted food fed to chickens.

McDonald *et al.* (1960) found a higher nasal carriage-rate of penicillin-resistant staphylococci in R.A.F. recruits coming from rural areas than in those coming from towns. They suggested that it might be due to drinking unpasteurised milk containing penicillin-resistant staphylococci. They noted that less than 0.5 per cent. of the recruits carried staphylococci resistant to tetracycline.

References

MCDONALD, J. C., MILLER, D. L., JEVONS, P., & WILLIAMS, R. E. O. (1960). *Pro. R. Soc. Med.* **53.** 255.
SMITH, H. W. (1959). *J. Path. Bact.* **77.** 79.
———, & CRABB, W. E. (1957). *Vet. Rec.* **69.** 24.
———, & ———. (1960). *J. Path. Bact.* **79.** 243.

Chronic Ringworm Infection of the Skin and Nails Treated with Griseofulvin. RUSSELL, B., FRAINBELL, W., STEVENSON, C. J., RIDDELL, R. W., DJAVAHISZIVILI, N., & MORRISON, S. L. (1960). *Lancet.* **1 (1960).** 1141.

The object of this trial was to measure the effects, both therapeutic and toxic, of prolonged therapy with griseofulvin by comparing a group of patients treated with griseofulvin with a control group given dummy tablets. Those in the treated group were given tablets sufficient for a daily dosage of 1.5 g. of griseofulvin.

At the beginning there were 76 patients in the trial, 41 men and 35 women; 72 of them were infected

with *Trichophyton rubrum*. Before completing 4 months in the trial 4 treated and 8 control patients had left the investigation for one reason or another, leaving 33 treated and 31 control patients for comparison. At the end of the 4 months' period 31 out of the 33 treated patients showed definite clinical improvement while 2 did not. After the same period only 1 of 31 control patients showed improvement while 30 did not. The sites of infection in the 33 treated patients were hands (21), feet (28), finger-nails (22) and toe-nails (32), multiplicity of site thus being the general rule. These 33 patients continued on griseofulvin treatment for periods ranging from 4 to 12 months. The response to treatment varied as between the patients and as between the sites involved.

Clinical improvement of skin lesions was noted in most instances by the 8th week. The skin usually appeared normal by the 16th week and all skin lesions had abated by the 36th (9 months). Patients with finger-nail lesions almost all improved by the 12th week, but only 62 per cent. of patients with toe-nail lesions showed improvement by this time. It took 10 months for 80 per cent. of patients with finger-nail lesions to have normal nails, but in this time only 12 per cent. of those with toe-nail lesions had normal nails.

Eleven patients were followed up for 1 year, 8 had affected finger-nails; in 6 the nails were normal at the end of the year, but only 2 out of 11 with affected toe-nails were normal at the end of the year.

Skin lesions—excluding toe-web lesions—were mycologically negative after 8 weeks in 40 per cent. of cases, but in many cases infection persisted for periods varying from 8 to 48 weeks. In 3 out of 11 toe-nail cases infection was still present after treatment for a year.

No side-effects attributable to griseofulvin were encountered.

It is concluded that griseofulvin is a safe effective remedy for chronic ringworm infections, but long-term treatment is necessary. G. F. B.

News and Comment

FIELD STAFF OF THE ANIMAL HEALTH DIVISION

At the conclusion of last Friday's Council meeting the President regretted the absence of members of the field staff of the Animal Health Division who, he said, were working to the limit of their capacity, as everyone well knew, in dealing with the current foot-and-mouth epidemic. Mr. Jennings proposed, and it was carried with applause, that Council should record its congratulations to the members of the field staff, and its admiration of their great efforts on the community's behalf.

ELECTION OF R.C.V.S. COUNCIL MEMBERS

In accordance with the provisions of the Veterinary Surgeons Act, 1948, 5 members of the Council, who must be members of the Royal College, will be elected in 1961 by members of the Royal College residing outside the Republic of Ireland.

Five present members of Council will retire at the Annual General Meeting in 1961 and are eligible for re-election, namely:—

R. F. Montgomerie, Esq., PH.D., B.SC., F.R.C.V.S., Wellcome Research Laboratories, Langley Court, Beckenham, Kent; G. Atkinson, Esq., M.R.C.V.S., 4 Compton Grove, Nairn Road, Canford Cliffs, Dorset; L. G. Anderson, Esq., D.V.M., M.R.C.V.S., 49 Cambridge Street, Aylesbury, Bucks.; T. M. Mitchell, Esq., M.R.C.V.S., D.V.S.M., Briony, Meadowfield Road, Stocksfield-on-Tyne, Northumberland; and Professor R. Lovell, D.SC., PH.D., M.R.C.V.S., D.V.S.M., Royal Veterinary College, Camden Town, London, N.W.1.

The term of office of the 5 persons elected in the place of the 5 members retiring by rotation will be 4 years.

Nominations of persons for election to the Council must be submitted in writing on a form which may be obtained from the undersigned, and which must be returned to him duly completed on or before January 31st, 1961.

Each such nomination form must bear the signature of the proposer and seconder, who must not be present members of Council, and must be countersigned by the nominee.

W. G. R. OATES,
Registrar
Veterinary Surgeons Acts, 1881-1948
9 Red Lion Square,
London, W.C.1.

B.V.A. CONFERENCE ON HYPOMAGNESAEMIA

This conference was opened by the President last Wednesday morning at the Victoria Halls, London. An audience of some 250 was present for the first session. It is intended to publish the official Proceedings as soon as extempore speeches and contributions from the floor have been gathered together, checked, and set up in type.

THE FOOT-AND-MOUTH OUTBREAK

The Foot-and-mouth Controlled Area restrictions which had been in force for some days in Northern and Central England, and in East Anglia, were withdrawn at midnight on Saturday, November 19th. *The normal infected area restrictions remain in force in the neighbourhood of confirmed outbreaks of disease.*

Sixteen markets in England have been involved in the present series of outbreaks. In the course of their investigation the Ministry's veterinary staff have made over 1,200 visits and examined over 10,000 animals. Up to the time of going to press there had been 114 outbreaks in England, and 46 in Scotland. Animals slaughtered have been, approximately, 11,300 cattle, 11,700 sheep, 5,250 pigs, and 22 goats. It is reported that compensation has amounted to about three-quarters of a million pounds.

SWINE FEVER VACCINATION SCHEME

At last Friday's Council meeting consideration was given to a resolution submitted by the Veterinary State Medicine Committee. That Committee had discussed, at its meeting on November 16th, details of the Cheshire and other area Schemes for the sale in markets of certified vaccinated pigs, these details having been supplied by the local B.V.A. Divisions or clubs. After full discussion in Council the following Resolution was approved:—

The Committee recommend to Council that the Cheshire Scheme for certified Crystal Violet vaccinated pigs be recommended to areas wishing to introduce such a scheme, but that Rule 6 (cost of vaccination) should read 5s. per piglet and 7s. 6d. per adult pig plus normal visiting fee; but that this should not be taken as mandatory but only as a recommendation. Rule 8 (c) (re time of sale after vaccination) should read 28 days instead of 14 days, and the whole scheme should be reviewed in November, 1961. The B.V.A. will issue code numbers to those veterinary practices participating in the scheme on application to 7 Mansfield Street.

PIG CONFERENCE AT TAUNTON

The high percentage of deaths and economic losses that may result either directly or indirectly from the immaturity of the piglet at birth was the basis of a paper given by Professor C. S. Grunsell of the University of Bristol at a Pig Conference held at Taunton on November 15th. This one-day conference, the third of a series organised by Glaxo Laboratories, Ltd., was aimed at the pig farming community of South-west England. Commencing with details of recent surveys of pig mortality in relation to age and disease, Professor Grunsell continued by describing the 2 major factors associated with the immature conditions of the new born piglet. Of fundamental importance was the absence of any heat-regulating mechanism resulting in a rapid drop from normal birth temperature (103° F.). The extent of this drop is closely related to the external temperature of the environment in which the pig finds itself. If this environmental temperature is low then the return to normal temperature can extend over a number of days during which time the young animal is susceptible to many external factors reducing the the chances of survival, for example disease, overlaying and suffocation.

The absence of any blood sugar-regulating mechanism of the young piglet was another matter discussed by Professor Grunsell. The immediate causes of hypoglycaemia in the piglet may originate in the sow or gilt. Infection, poor nutrition, poor mothering or agalactia of the sow all mean reduced milk intake and the development of hypoglycaemia. Whatever the hazards waiting for the piglet after birth, some of which are not foreseeable, it was emphasised by the speaker that many can be greatly reduced by producing piglets of high birth weight and by maintaining a good quality milk production in the sow.

These points were further elaborated on by Mr. G. A. Childs, Head of the Glaxo Animal Feeds Formulation Dept., who described recent work which showed that the birth weight of pigs, and litter sizes, were dependent more on nutrition than on heredity.

Professor Grunsell concluded by relating disease with husbandry, using virus pneumonia as an indication of disease spread within a pig unit. The importance of this relationship was stressed in relation to the work of the veterinary profession within the pig industry. The other speakers at the conference were Dr. W. E. Coey, lecturer at the University of Belfast, who spoke on pig selection, and Mr. S. R. Wragg of the University of Bristol who discussed the economics of the pig industry.

CIRCUS IN AID OF ANIMAL HEALTH TRUST

Once again, this Christmas, the famous Bertram Mills Circus are giving a gala performance in aid of the Animal Health Trust. It will take place on December 23rd, at 7.30 p.m. at Olympia.

With regard to this particular function, the Trust has a most admirable plan, by which those who cannot take tickets are asked to contribute in order that tickets may be given free to such organisations as Dr. Barnado's Homes, the Star and Garter Homes for Disabled Ex-servicemen, the Chelsea Pensioners, etc. The writer of this note has been present in other years and has seen the delight of the orphaned children and others in being invited to the Circus: so this really is a good cause. The price of tickets ranges from 5s. to 16s., with a few special box seats at 17s. 6d.

IRISH GOVERNMENT RESTRICT HORSE EXPORTS

The Irish Government has announced that from December 1st licences will be required for the export of horses to destinations other than Britain, Northern Ireland, the United States, and Canada. The export of working-type horses aged 7 years or over will not be allowed from next spring unless assurances are given that the animals will be slaughtered within a distance of 30 miles from the point of disembarkation. New regulations will be introduced to improve the conditions under which horses are shipped.

It is understood that the new regulations, while not actually prohibiting the traffic in live horses, are likely to make it economically not worthwhile.

The Government's announcement also said that a company had been formed for large-scale production and export of horse-meat. Work was beginning immediately on the construction of a new factory which would conform to the technical requirements of the Department of Agriculture for the production of horse-meat for human consumption.

THE REGISTER OF VETERINARY SURGEONS

Mr. Ronald John Olds, B.V.SC. (Queensland), Clare College, Cambridge, was registered in the Commonwealth List of the Register of Veterinary Surgeons on November 15th, 1960.

THE ROYAL COLLEGE OF VETERINARY SURGEONS

Library

The packing of the library for removal will commence on Thursday, December 1st, 1960, and the actual removal will be carried out over the week-end commencing Friday, December 10th.

From Thursday, December 1st onwards, until further notice, it will be possible only to provide a limited library service.

As soon as the library in the temporary College building is available to give full services a notice will appear in THE VETERINARY RECORD.

UNIVERSITY NEWS

Glasgow

Mr. E. W. Fisher, B.SC. (Edin.), M.R.C.V.S., graduated Ph.D. of Glasgow University on Saturday, November 5th, 1960.

R.C.V.S. OBITUARY

We record with regret the death of the following member of the profession:—

PRYTHERCH, Huw Eirwyn, of The Laurels, Pensarn, Abergele, Denbighshire. Graduated Edinburgh, July 14th, 1939. Died November 16th, 1960, aged 44 years.

PERSONAL

Mr. E. R. Corrigall will appear in the Midland B.B.C. farming programme on Monday, November 28th, at 6.10 p.m. The subject will be the necessity of the eradication programme in dealing with foot-and-mouth disease. The chair will be taken by "the Midland vet."

Dr. S. B. Kendall, Head of the Parasitology Department at Weybridge, has been invited to present a paper entitled "Experimental Chemotherapy and the Control of Parasitic Disease" at a Symposium on the Control of Parasitic Disease to be held at the Czechoslovak Academy of Science in Prague, November 21st to 23rd.

Birth

KNEEN.—On November 15th, 1960, at Dundee Royal Infirmary, to Maureen, wife of John E. Kneen, B.V.SC., M.R.C.V.S., Hill House, Arbroath, a son, Thomas Henry Quintin.

COMING EVENTS

November

28th (Mon.). EAST YORKSHIRE CLINICAL CLUB. Meeting at the Talbot Hotel, Malton, 8. p.m.

30th (Wed.). A.V.T. & R.W. SCOTTISH REGIONAL GROUP. Meeting at the Royal (Dick) School of Veterinary Studies, 2.30 p.m.

December

1st (Thurs.). LAKELAND VETERINARY ASSOCIATION. Annual Dinner Dance at the Old England Hotel Bowness-on-Windermere, 7.30 p.m.

CENTRAL VETERINARY SOCIETY. Meeting at the Royal Veterinary College, Camden Town, N.W.1, 6 p.m.

2nd (Fri.). NORTH OF ENGLAND VETERINARY MEDICAL ASSOCIATION. Annual Dinner-Dance at the White Swan Hotel, Alnwick.

ROYAL COUNTIES VETERINARY ASSOCIATION. Ordinary General Meeting at the Caversham Bridge Hotel, Reading, 2.30 p.m.

MIDLAND COUNTIES VETERINARY ASSOCIATION. Joint Meeting with the Shropshire Veterinary Club at the Oak Hotel, Shelton, Shrewsbury, 8 p.m.

SHROPSHIRE VETERINARY CLUB. Joint meeting with the Midland Counties Veterinary Association (see above).

7th (Wed.). LAKELAND VETERINARY ASSOCIATION. Meeting at the George Hotel, Penrith, 6 p.m.

CORNWALL VETERINARY CLINICAL CLUB. Annual General Meeting at the Red Lion Hotel, Truro, 7.30 p.m.

8th (Thurs.). ESSEX VETERINARY SOCIETY. Meeting in the Judges Room at the Saracen's Head, Chelmsford, 7.30 p.m.

EAST MIDLANDS DIVISION. Joint Meeting with the Staffordshire & Derbyshire Veterinary Club at the Royal Hotel, Ashby-de-la-Zouch, 8 p.m.

9th (Fri.). BRITISH VETERINARY POULTRY ASSOCIATION. 14th Meeting of the Association at Unilever House, London, 2.15 p.m.

14th (Wed.). SUSSEX VETERINARY SOCIETY. Meeting at the Old Ship Hotel, Brighton, 2.30 p.m.

15th (Thurs.). WESTERN COUNTIES VETERINARY ASSOCIATION. Meeting at the Rougemont Hotel, Exeter, 2.30 p.m.

SOUTH EASTERN VETERINARY ASSOCIATION. Meeting at the Royal Star Hotel, Maidstone, 2.30 p.m.

TECHNICAL DEVELOPMENT COMMITTEE

The next meeting of the Technical Development Committee will be held at 7, Mansfield Street, London, W.1, at 10.30 a.m. on Monday, December 5th, 1960.

ADDRESSES OF DISEASE INFECTED PREMISES

The list given below indicates, first the county in which are situated the premises on which disease has been confirmed, followed by the postal address and date of outbreak.

Anthrax

Ayr. Barglachan Farm, Auchinleck, Cumnock (Nov. 15); Mill O'Shield, Drongan (Nov. 17).

Ches. Crewe Hall Farm, Farndon, Chester (Nov. 16).

Lanarks. Cattle Court, Springhill, Carnwath (Nov. 15).

Northants. Jubilee Street Dairy, Irthlingborough, Wellingborough (Nov. 18).

Sussex. New House Farm, Twineham, Haywards Heath (Nov. 15).

Foot-and-Mouth Disease

Aberdeen. Whitefield Farm, Old Meldrum; Wilsons Croft, Ythanbank (Nov. 15); Northtown, Smithycroft, Allathan, New Deer; Meikle Haddo, Newburgh (Nov. 16); Loanhead, New Deer (Nov. 19); Mains of Pitfow, Mintlaw, Peterhead (Nov. 20).

Clackmannanshire. Cartary Farm, Clackmannan (Nov. 20).

Cumberland. Brisco Hill, Longtown, Carlisle (Nov. 18).

Derbys. 77 Main Street, Smalley (Nov. 19); Mount Pleasant Farm, Belper Lane, Belper (Nov. 20).

Durham. North Follingsby Farm, Wardley, Gateshead (Nov. 17); Glebe Farm, Houghton-le-Spring (Nov. 19).

Lanarks. Corporation Slaughterhouse, Souter House

Road, Coatbridge; Browns Bank, Biggar (Nov. 16); Hill End Farm, Caldercruix, Airdrie; Shields Farm, Milton of Campsie, Glasgow (Nov. 18); Kiln Pot Hall, Carnwath; Balcastle Farm, Kilsyth, Glasgow (Nov. 20).

Leics. Village Farm, Little Dalby, Melton Mowbray (Nov. 16).

Norfolk. Orchard Farm Cottage, Saxlingham; Church Farm, Elsing, East Dereham (Nov. 15); Old Hall Farm, Trowse, Norwich; Hall Hill Farm, Great Ellingham (Nov. 16); Mill Farm, Blickling, Aylsham, Norwich; Oak Tree Farm, Marsham, Norwich; Salletts Farm, Saxlingham, Norwich; Poultry Farm, Skeyton, Nth. Walsham (Nov. 17); St. Faith Road, Old Catton, Norwich; High Home Farm, Little Melton, Norwich; Brickfield Farm, Old Costessey, Norwich (Nov. 20).

Northumberland. East Oldcoats, Ponteland, Newcastle upon Tyne (Nov. 15); Hallington Fell Farm, Hallington (Nov. 17).

Notts. Home Farm, Caythorpe (Nov. 17); Church View Farm, South Scarle, Newark; Lowdham Grange Farm, Lowdham (Nov. 19); Hockerton Manor, Hockerton, Southwell (Nov. 20).

Orkney. Roeberry Farm, South Ronaldsay (Nov. 19).

Suffolk. Smallwood Farm, Bradfield St. George, Bury St. Edmunds; Lords Meadows, Street Farm, Bren Eleigh (Nov. 17).

West Lothian. Birkenshaw Farm, Armadale, Bathgate (Nov. 19).

Yorks. Wold Dyke Farm, Middleton-on-the-Wolds, Driffield (Nov. 15).

Fowl Pest

Beds. Manor Farm, Caddington, Luton (Nov. 16).

Essex. Appledore, North Hill, Horndon-on-the-Hill, Stanford-le-Hope (Nov. 17); Claybury Hospital Farm, Woodford Bridge (Nov. 18); Arden Hall, Norndon-on-the-Hill, Stanford-le-Hope; Fair View Farm, Chigwell (Nov. 19).

Glam. Westfield, School Road, Dyffryn Cellen, Neath; 28 School Road, Onllwyn, Neath (Nov. 16).

Lancs. Brade Farm, Catforth, Preston (Nov. 15).

Norfolk. 51 Church Street, Sheringham; Mautby Lodge, Filby, Great Yarmouth; Thorpe Hall, Mendham, Harleston; Grange Farm, Filby, Great Yarmouth; White House Farm, North Tuddenham, Dereham (Nov. 15); 4 Long Row, The Lizard, Wymondham; Wash Farm, Banham, Norwich; Chestnut House Farm, Old Buckenham, Attleborough; Cades Hill Farm, Attleborough; Short Lane, Sheringham; Marsh Lane, New Buckenham, Norwich (Nov. 16); West Farm, Barnham, Thetford; Mill Cottage, Weybread, Diss (Nov. 17); Southfields, Wicklewood, Wymondham; Long Stratton, Norwich; Butts Lane, Little Fakenham, Thetford (Nov. 18); Land off Mill Lane, Hockwold, Thetford; Primrose Farm, Southburgh, Thetford (Nov. 19); The Lilacs, Hockwold, Thetford; Walcis Farm, Great Witchingham, Norwich; The Flaxlands, Carleton Rode, Norwich (Nov. 20).

Salop. Fernlea, Prees Green, Prees, Whitchurch; Jessamine Holding, Prees Green, Whitchurch (Nov. 17).

Somerset. Highlands Farm, Ash, Martock (Nov. 15); Fosse Way, Martock (Nov. 16); The Bell, Ash, Martock; Colwyn Poultry Farm, Coles Cross, Tintinhull, Yeovil (Nov. 18).

Suffolk. Park Cottage, Drinkstone, Bury St. Edmunds; Garden, Hedenham, Bungay (Nov. 15); 24 Newmarket Road, Bury St. Edmunds; Little Town Farm, Cratfield, Halesworth (Nov. 16); Fermanagh, Town Street Road, Brandon (Nov. 17); Green Farm, Timworth, Bury St. Edmunds; Rathkeltair, Fornham St. Martin, Bury St. Edmunds; Town Street Road, Brandon; 9 Whitehorse Street, Brandon; 93 Duchess Drive, Cheveley, Newmarket (Nov. 20).

Surrey. Weydown, Pitch Place, Worplesdon, Guildford (Nov. 18).

Yorks. Westside Farm, Nun Monkton; Apple Tree Farm, Nun Monkton (Nov. 15).

Swine Fever

Ches. Brook Farm, Cholmondeston, Winsford (Nov. 15).

Essex. Norbec, Lower Bedfords Road, Romford (Nov. 15).

Hants. Bere Hill Farm, Andover (Nov. 15).

Lancs. Worlds End Farm, Benny Lane, Droylesden, Manchester; Boltons Farm, Blackgate Lane, Tarletonk, Preston; Turners Farm, Barnacre, Garstang, Preston (Nov. 15); Barton House, Catforth, Preston (Nov. 16); Newshed Farm, Barton Road, Stretford, Manchester (Nov. 17).

Lincs. Home Farm, Leadenham (Nov. 16).

Mont. Garth Holding, Guilsfield, Welshpool (Nov. 16).

Norfolk. Blockhouse, High Mill Road, Cobholm, Great Yarmouth; Ivy Farm, Swardeston, Norwich (Nov. 16); Bridge Farm, Antingham, North Walsham (Nov. 18).

Salop. Parkley Farm, Iscoyd, Whitchurch (Nov. 18).

Yorks. Balkwood Farm, Sutton under Whitestonecliffe, Thirsk; Well Hall, Farmyard, Well, Bedale (Nov. 15); Silver Hall Farm, Skirlaugh, Hull. Lund House Green Farm, Lund House Green, Harrogate (Nov. 17); Chapel Farm, Welham Bridge, Spaldington, Goole (Nov. 18).

Letters to the Editor

The views expressed in letters addressed to the Editor represent the personal opinions of the writer only and their publication does not imply endorsement by the B.V.A

SCIENTIFIC

Streptothricosis in Zebra and Donkeys and Demodectic Mange in Eland in Kenya

Sir,—Resulting from the examination of the dried skins of donkeys and of a number of different game animals, streptothricosis has been identified in zebra and donkeys and demodectic mange in eland.

The cases of streptothricosis were mild both in the zebra and in the donkeys. They were characterised by small scabs, which were located near the backbone line of the donkey skins and near the flanks of the zebra.

The presence of streptothricosis was confirmed by making smears from the scabs and staining them by Gram's method, which revealed the typical segmented filaments.

Demodectic mange was identified by the microscopic examination of smears made from lesions, when a number of demodex mites were seen.

Yours faithfully,
H. F. GREEN.

The Veterinary Research Laboratory,
The Department of Veterinary Services,
Kabete,
Kenya.
November 1st, 1960.

GENERAL

Veterinary Education

Sir,—I would like to refer to Miss Joshua's letter of October 26th and make two points.

The first relates to the use of visiting lecturers. It has been the practice in Glasgow Veterinary

School to invite visiting lecturers to talk to the senior students about their own special work and interests. These lecturers have included research workers, veterinary investigation officers and surgeons specialising in particular techniques. Thus, during their last 2 years, students here may receive about 25 to 30 lectures from 15 to 20 different people, each specialising in some branch of veterinary science. Our object in doing this is not so that students can adapt to the hurly-burly of everyday veterinary life after they leave School, but to help them to understand something of how the scientific training they received may be applied in the field, and stimulate and interest them in a way that can be done only by those who are intimately connected with a particular subject.

Secondly, I should say that the whole theme of my paper is that we are not attempting to turn out finished, ready-made practitioners on graduation, but students well-trained in the fundamentals of veterinary medicine and surgery, able to apply their training to any of the fields of veterinary endeavour in the post-graduate period.

Yours faithfully,
W. L. WEIPERS.

University of Glasgow,
Veterinary Hospital,
Bearsden Road,
Bearsden,
Glasgow.
November 16th, 1960.

Sir,—I refer to the correspondence on veterinary education which has been published recently in THE VETERINARY RECORD. I do not doubt that many practising veterinary surgeons know a great deal which would be of value not only to students but to all—including teachers. Much of this experience is not suitable for dissemination because it is either fragmentary and unrecorded, or subjective. I suggest that a good way to lessen the continuous loss of what could so easily be real knowledge, would be for veterinary surgeons to publish more of their opinions and observations in detail, so that they can be critically evaluated by students, teachers and colleagues alike. If this hidden wealth of knowledge is too indeterminate to be expressed in writing, then it is not fit for students.

I agree with Miss Joshua's remarks, but surely the essential thing to impart to the student is a sound and scientific education, some traces of which, in an adaptable man, will survive in the "hurly-burly of everyday veterinary life."

Yours faithfully,
B. F. FELL.

33 Belvidere Street,
Aberdeen.
November 16th, 1960.

The Medical Profession and Ourselves

Sir,—I think your leader of last week painted much too rosy a picture of the advantage to the veterinary profession of collaboration with the medical profession. On the contrary, I would assert that by following too closely the pattern of medical education, the evolution of veterinary education has been retarded. After all, it took a second World War to remind those responsible for veterinary education that the profession's main *raison d'être* was to increase the efficiency of the livestock industry, and that, consequently, animal husbandry and the medicine and surgery of farm animals should be of paramount importance. (Hence the development of field stations, and incidentally, the proper financing of veterinary education which we now enjoy.) Having recognised the proper function of the profession, it has always seemed to me curious that the Loveday Committee should have gone out of its way to advise that veterinary Schools should be allied with medical rather than agricultural departments in universities. I believe that it is because of this unfortunate alliance that, even to-day, veterinary Schools are still finding it difficult to implement the Loveday Committee's recommendations in respect of the teaching of animal husbandry and clinical medicine and surgery of farm animals. The veterinary field stations are not only isolated from other university departments but also from their own parent institutions. How different it could have been if the veterinary Schools had been incorporated in provincial universities with strong agricultural departments, like Reading, Leeds and Aberystwyth, for example. The veterinary schools might then have contributed to agriculture as significantly as they have done in Scandinavia.

Yours faithfully,
G. H. ARTHUR.

Royal Veterinary College,
Field Station,
Hawkshead House,
Hawkshead Lane,
North Mimms,
Hatfield, Herts.
November 22nd, 1960.

A Veterinary Centre

Sir,—I should like to lend my support to the letter on the above subject by Mr. G. N. Henderson in THE VETERINARY RECORD of November 12th.

I feel that, in principle, the idea is common-sense, laudable and far-seeing.

Yours faithfully,
JOHN LAWSON.

106, New Road,
Bromsgrove,
Worcs.
November 12th, 1960.

Anaemia in Trichostrongylid Infestations

Sir,—I refer to the B.V.A. Congress paper, "Anaemia in Trichostrongylid Infestations" by J. Allan Campbell and A. Campbell Gardiner, of Moredun Institute (*Vet. Rec.* 1960. **72.** 1,006).

Campbell-Gardiner have presented one of the most difficult kinds of scientific paper—the paper that depends on the interpretation of other people's measurements, rather than on the recording of

original observations. Such arm-chair science is, of course, entirely permissible, especially at congresses where—in order to stimulate discussion—hypotheses need not be over-embarrassed by facts.

But such papers are deceptively difficult to write. Modern authors are apt to forget that not all earlier workers were fools, nor were they knaves, nor, indeed, were they completely lacking in statistical experience. A paper by Holman and myself of some 20 years ago comes in for half a column of acid comment. Were we really so stupid? And if silly then, are we sillier now for not having changed our minds?

It is irksome, Sir, to be misrepresented; to have it alleged that we used a "dubiously permissive argument"; to have it inferred that we did not consider (and discard) the hypothesis advanced by the Campbell-Gardiner school. Nor did we seek to "disrepute Fourie's conclusions." Fourie's excellent records were of the greatest assistance in helping us to report our findings.

I do not wish to labour the point, for Holman and I are not the only authors to receive the blunt end of the Campbell-Gardiner pen. What I would say, however, is that papers of this type must not be too clever, or they lose their punch. They must not be too rude, or they lose their meaning. And they must not be too abstruse, or no one will bother to read them. I am pleased that Campbell-Gardiner plan to move from hypothesis to experimentation, for at the end of their paper they say:

"In anaemias whose aetiology is different, the quantitative relationship with the casual infestation will almost certainly be different from that described so far for *H. contortus*, but the work on these awaits an undertaking and until then speculation is fruitless."

It is reassuring that Campbell-Gardiner accept that their hypothesis lacks nothing except proof.

Yours faithfully,
I. H. PATTISON.

42, Wendan Road,
Newbury,
Berks.
November 17th, 1960.

A Useful Accessory

Sir,—At this time of year there is a great increase in the numbers of rectal examinations of cattle made to determine if pregnancy exists, and if not, why not. This year I have been using a disposable plastic bag or handisleeve,* measuring approximately 2 ft. 3 in. × 9 in., on my arm; and am well satisfied with the results.

I was sceptical, believing that only with bare fingers could I determine pregnancy when I like to do so, that is at 5 weeks in heifers and 7 weeks in cows. However, the plastic is so thin and strong that there is little or no interference with tactile sense, and there is complete protection. The advantages are many; one is spared the embarrassing dirty tan especially prevalent in autumn and spring, when explanations to small-animal clients only make matters worse. One is spared the excoriation caused by the annoying tail hairs when more than a dozen rectals are done at one time. But, apart from personal hygiene, the use of a disposable sleeve obviates the possibility of spread of diseases such as winter dysentery, haemorrhagic enteritis and Johne's disease. It also prevents damage to the rectal mucosa by finger nails. However, I find the sleeve most useful when there is more than uterine infusion to be done. I use separate Neilson's with record mount for each cow, but the same syringe. Previously I had to wash and dry my hands to recharge the syringe, whereas now I can just pull off the sleeve to handle the bottles.

Removal of the placenta in cows is tackled without danger of contamination of one's arm with either smell or bacteria, if one feels that this task must be done, as many believe, on the third day. I suppose the third day was chosen by our predecessors because it is the most difficult time and a job must not look too easy. The sleeve can be kept in place by an arm shield.

Finally, I find these sleeves useful containers for *post-mortem* specimens. Like some others I have been politely told that the contents of a parcel had leaked in transit. It could not be otherwise because seldom can I find a tin that is watertight.

The cost of the sleeves?—about 2¾d. each.

Yours faithfully,
Wm. J. JORDAN.

Green Paddocks,
Pulford, near Chester.
October 25th, 1960.

* Flexan Products, Brockenhurst.

Binding "The Veterinary Record"

Sir,—The chief value of any scientific journal is in having it to refer to in later years. For this purpose, as time goes on, binding becomes a "must." I have always sent my VETERINARY RECORDS to the printers for binding and their charge used to be quite reasonable. Now, however, after two substantial jumps in price, the charge, £1 15s. per volume, is about twice what it was only a few years ago. This seems rather exorbitant. In the interest of those of your readers who sufficiently prize your journal to wish to preserve it, could you advise us in the pages of THE VETERINARY RECORD where we can get binding done at a reasonable figure?

Yours faithfully,
W. H. PARKER.

Knayton Lodge Flat,
Knayton,
Thirst,
Yorks.
November 6th, 1960.

The price quoted by our correspondent is that charged by THE RECORD's own printers. Enquiries have shown that Messrs. Ryman and Co. would make an exactly similar charge, while Messrs. W. H. Smith and Son will charge 45s. for binding half-yearly volumes. In the latter case there is the advantage that members can take their unbound copies to any branch, and they will be forwarded to the bindery from there.